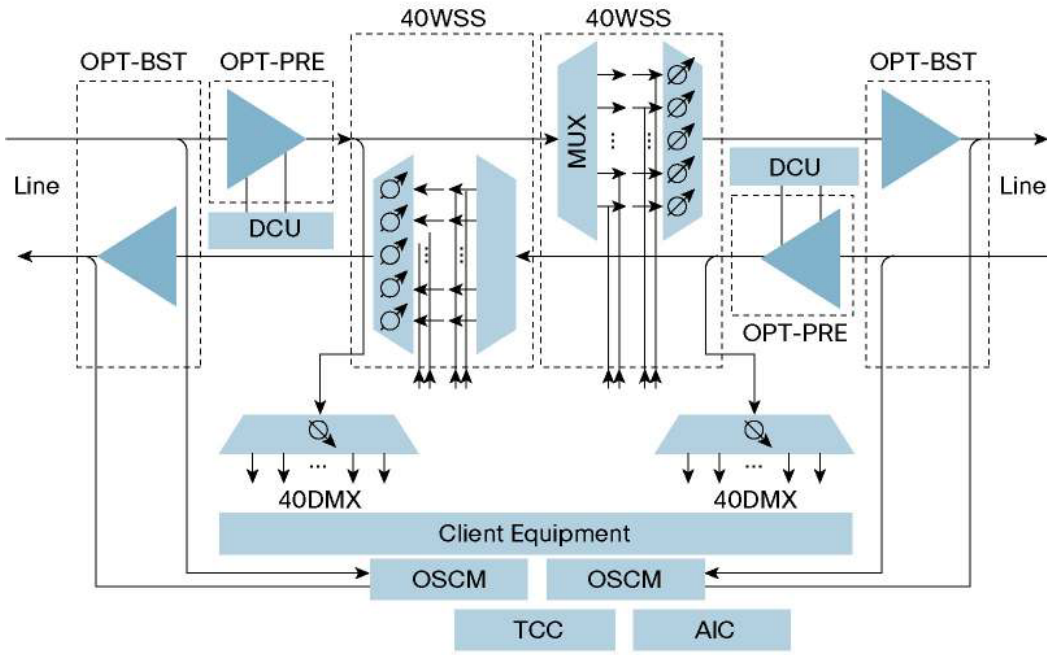
EXHIBIT K

APPENDIX A

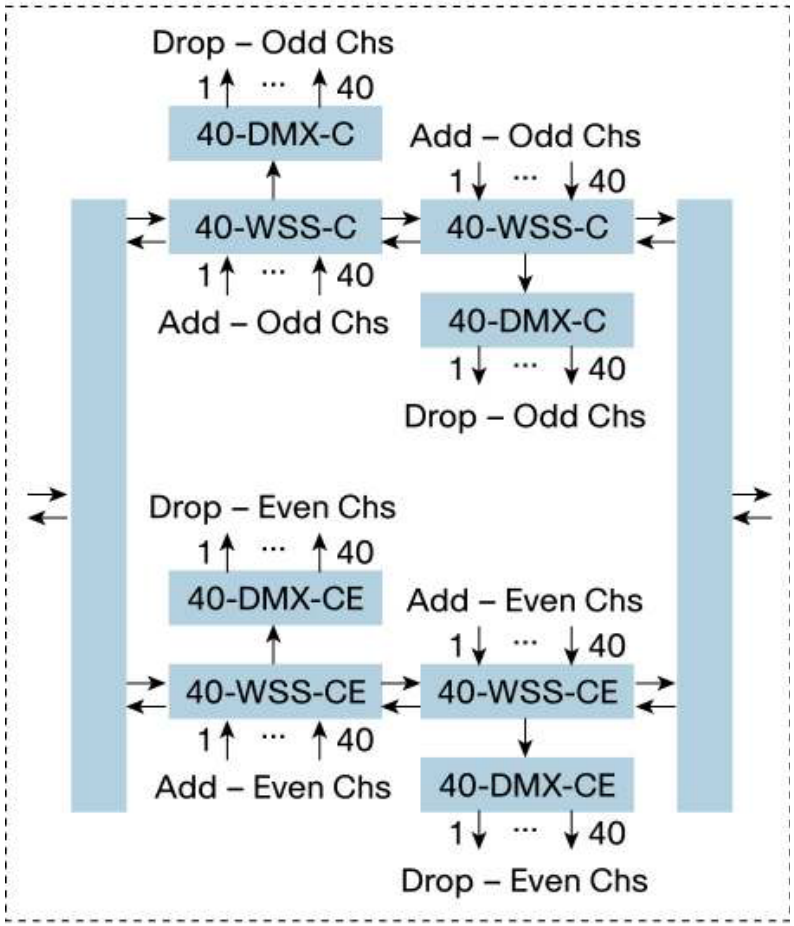
Claims 1-4, 9, 10, 13, 17, 19-23, 27, 29, 44-46, 53, 61-65 of U.S. Patent No. RE42,678
v.
Cisco Reconfigurable Optical Add Drop Multiplexers ("ROADM") Accused Devices

Claim	Product Analysis
1. A wavelength-separating-routing apparatus, comprising:	Cisco makes, uses, sells, imports, and/or offers to sell reconfigurable optical add drop multiplexers ("ROADMs") and other products that incorporate wavelength selective switches ("WSSs"), each of which is a wavelength separating-routing apparatus. Several documents detail the functionality of Cisco's ROADM products, including: • "Data Sheet: 40-Channel Reconfigurable Optical Add/Drop Multiplexing Portfolio for the Cisco ONS 15454 Multiservice Transport Platform," dated 1992-2007 ("ONS 15454 Data Sheet"); • "Data Sheet: Cisco NCS 2000 Service Line Cards," dated 2013 ("NCS 2000 Data Sheet 1"); • "Data Sheet: Cisco Network Convergence System 2000 ROADM and Amplifier Line Cards," dated 2013 ("NCS 2000 Data Sheet 2"); • "Cisco ONS 15200 Series DWDM Systems," from Cisco's website (www.cisco.com/c/en/us/products/optical-networking/ons-15200-series-dwdm-systems/index.html) ("ONS 15200 Webpage"); • "Data Sheet: Cisco ONS 15216 C L-Band Splitter/Combiner Module for Cisco ONS 15454 MSTP" dated 1992-2005 ("ONS 15200 Data Sheet"); • "Cisco NCS 2002 and NCS 2006 Line Card Configuration Guide, Release 10.x.x," chapter titled "Provisioning Reconfigurable Optical Add/Drop Cards," which "describes the line cards deployed in reconfigurable optical add/drop (ROADM) networks," pp12-16, which focus on the "40-WSS-C and 40-WSS-CE Card," and pp 31-38, which focus on "Single Module ROADM (SMR-C) Cards" ("ROADM Configuration Chapter"); and • information and documents available from Cisco's website (www.cisco.com) ("Website"). According to Cisco's ONS 15454 Data Sheet: "The Cisco® ONS 15454 Multiservice Transport Platform (MSTP) (Figure 1) provides a comprehensive, intelligent dense wavelength-division multiplexing (DWDM) solution for expanding metropolitan (metro) and regional bandwidth."

	Figure 1 is labeled as "40-Channel Wavelength Cross-Connect (40-WXC), Wavelength Selective Switch (40-WSS), Multiplexer (40-MUX), and Demultiplexer (40-DMX) Units." "While Wavelength Selective Switch (WSS) units provide degree-2 type reconfigurability (drop wavelength in a node vs. let it pass through the node), an ROADM node based on 40-WXC units can support up to degree-8 reconfigurability. This means that for each wavelength it is possible to decide if it has to be locally dropped or routed to any of the other 7 pass-through directions of the node. Such a capability not only enhances the flexibility of the DWDM transport network but also dramatically reduces the need for costly transponders to perform optical-to-electrical-to-optical conversion (typically 2 transponders/crossponders per add/drop channel or wavelength)." "As even in complex mesh network topologies it is likely that degree-2 reconfigurability would be enough for most of the node, the 40-channel ROADM portfolio includes also two different versions of the 40-WSS units, one operating on the odd channels of the C band spectrum (40-WSS-C) and the other one operating on the even channels of the C band spectrum (40-WSS-CE). The units can be used in conjunction with existing 32-channel ROADM solutions and with 40-WXC units to provide the greatest degree of flexibility for Cisco ONS 15454 MSTP deployments." "Embedded automatic power control mechanisms feature the possibility to interface with different types of DWDM units without requiring external attenuators. Used in conjunction with the 40-channel Multiplexer and 40-channel Demultiplexer allows to manage local add/drop traffic of the specific direction supported by the 40-WXC unit." "Embedded automatic power control mechanisms feature the possibility to interface with different type of DWDM units without requiring external attenuators." A chart in Cisco's ONS 15454 Data Sheet lists the components within the 40-Channel ROADM Units, including a "40-Channel Wavelength Selective Switch" The following figure 3 from Cisco's ONS 15454 Data Sheet is a chart of the "MSTP 40-Channel Degree-2 ROADM Node" and shows how wavelength selective switches (labeled "WSS") are integrated within a Cisco's ROADM:



The following figure 4 from Cisco's ONS 15454 Data Sheet is a chart of the "MSTP 80-Channel Degree-2 ROADM Node" and shows how wavelength selective switches (labeled "WSS") are integrated within a Cisco's ROADM and how Cisco's ROADM can add and drop signals:

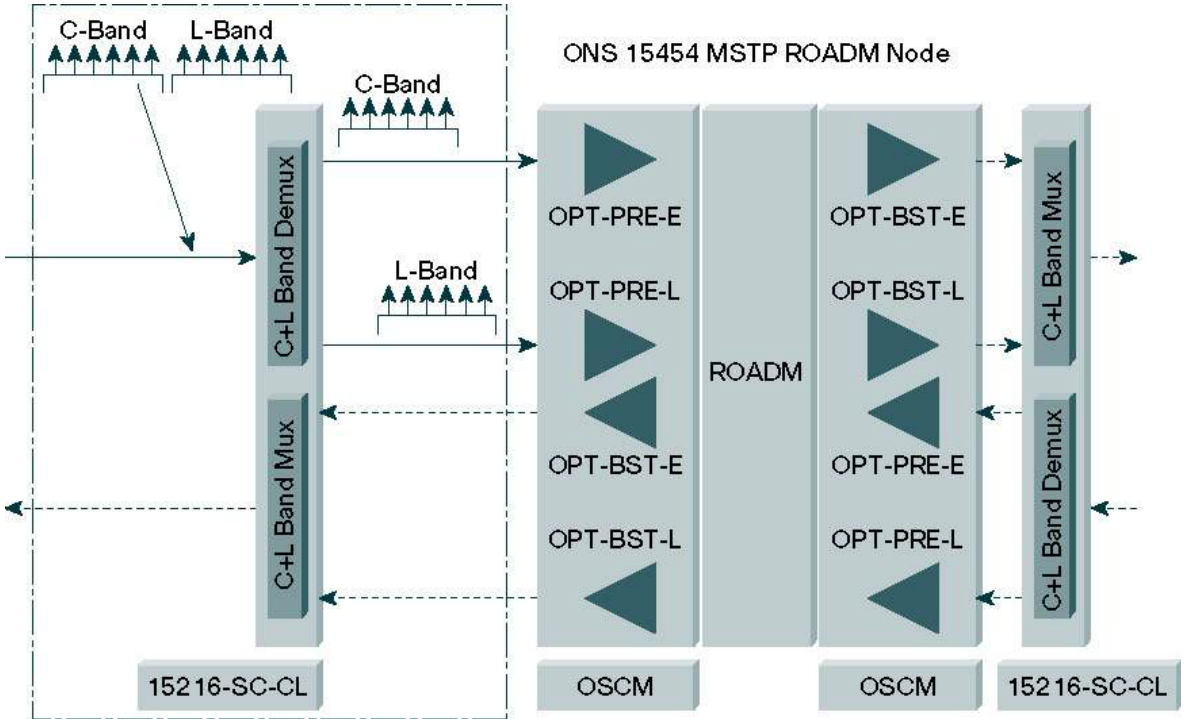


According to Cisco's ONS 15200 Data Sheet and ONS 15200 Webpage, both of which describe the ONS 15200 series of Cisco products, the ONS 15216 is the front end to the WSS ROADM in the ONS 15454. The ONS 15216 and ONS 15454 are integral to one another, so the ONS 15216 cannot work without the ONS 15454 and vice versa.

According to Cisco's ONS 15200 Webpage, "Cisco ONS 15200 Series DWDM Systems consist of intuitive,

compact, passive devices used in a variety of applications. These range from low latency, point-to-point data center interconnect to passive or reconfigurable optical add/drop multiplexer- (ROADM) based metropolitan rings."

According to Cisco's ONS 15200 Data Sheet, Figure 3 describes "Cisco ONS 15216 C+L-Band Splitter/Combiner Module Deployed in a Cisco ONS 15454 MSTP ROADM Node" and depicts the relationship of Cisco's 15200 series products with Cisco's 15454 ROADM as follows:

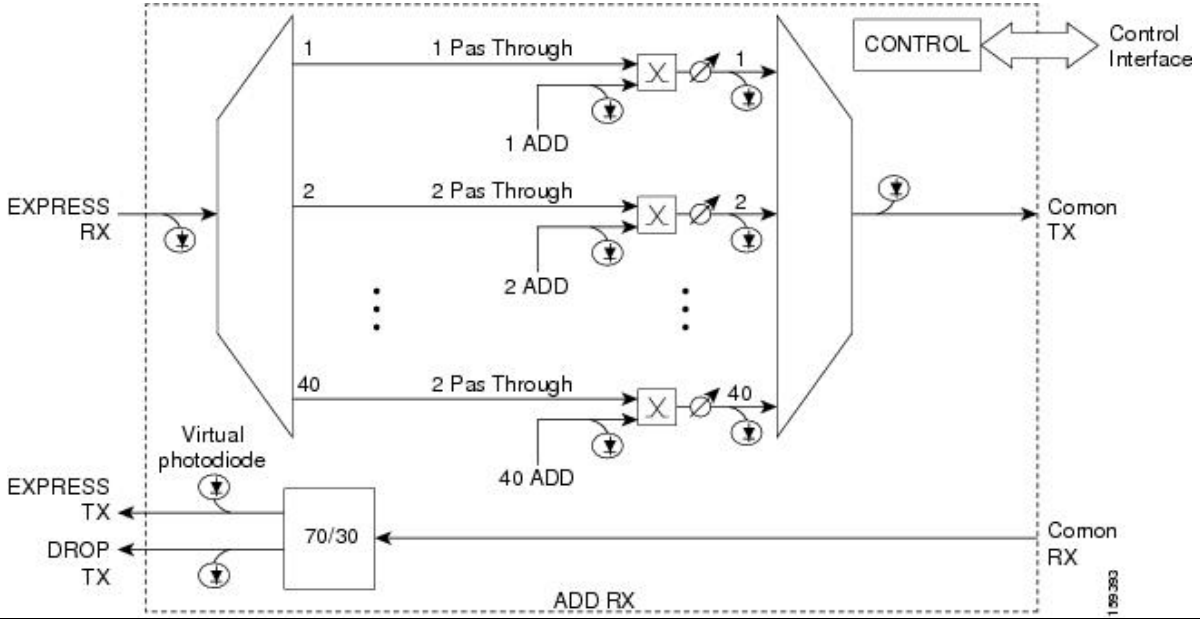


According to Cisco's ROADM Configuration Chapter, the Single Module ROADM (SMR-C) Cards are "single-slot 40-channel single module ROADM (SMR-C) cards" and they "integrate the following functional blocks onto a single line card:

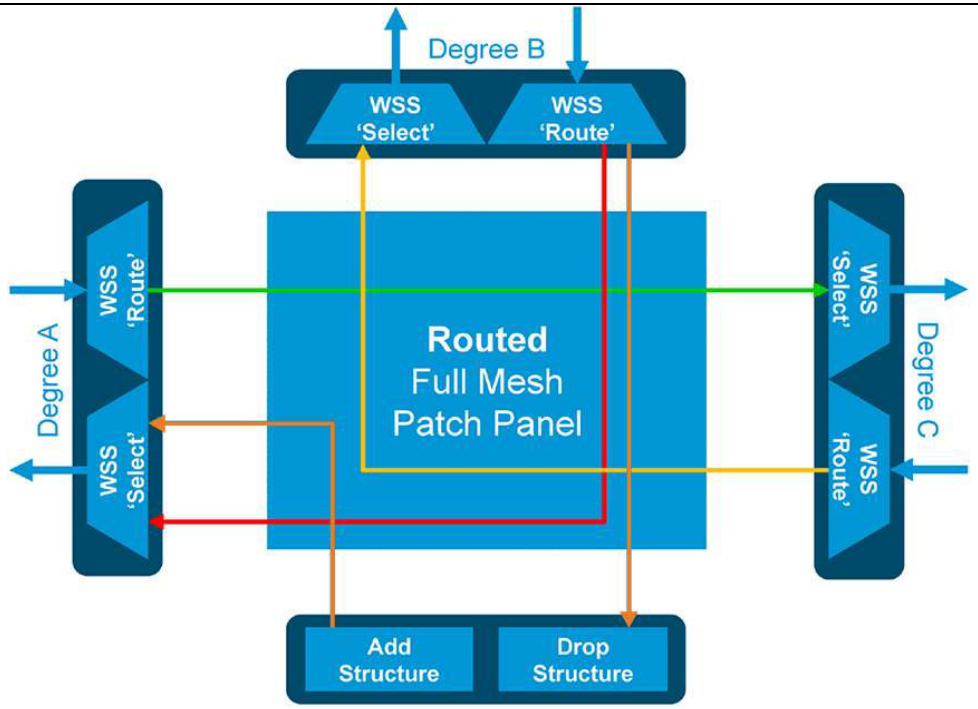
"• Optical preamplifier

• Optical booster amplifier

	• Optical service channel (OSC) filter • 2x1 wavelength cross-connect (WXC) or a 4x1 WXC • Optical channel monitor (OCM)" According to Cisco's ROADM Configuration Chapter, the Single Module ROADM (SMR-C) Cards "can manage up to 40 channels spaced at 100GHz on each port." Cisco's ROADM Configuration Chapter about provisioning reconfigurable optical add/drop cards describes the "40-WSS-C and 40-WSS-CE Card" as follows: "The double-slot 40-channel wavelength selective switch C-band (40-WSS-C) or the double-slot 40-channel wavelength selective switch even-channel C-band (40-WSS-CE) card switches 40 ITU-T 100-GHz-spaced channels identified in the channel plan (Table 4: Channel Allocation Plan or Table 5: Channel Allocation Plan) and sends them to dedicated output ports. The 40-WSS-C or 40-WSS-CE card is bidirectional and optically passive. The card can be installed in Slots 1 to 6 and 12 to 17 "The 40-WSS-C or 40-WSS-CE features include: • Receipt of an aggregate DWDM signal into 40 output optical channels from the Line receive port (EXP RX) in one direction and from the COM-RX port in the other direction. • Per-channel optical power monitoring using photodiodes. • Signal splitting in a 70%-to-30% ratio, sent to the 40-DMX-C (or 40-DMX-CE) for dropping signals, then to the other 40-WSS-C (or 40-WSS-CE) card. • Aggregate DWDM signal monitoring and control through a variable optical attenuator (VOA). In the case of electrical power failure, the VOA is set to its maximum attenuation for safety purposes. A manual VOA setting is also available." "Within the 40-WSS-C or 40-WSS-CE card, the first AWG opens the spectrum and each wavelength is directed to one of the ports of a 1x2 optical switch. The same wavelength can be passed through or stopped. If the pass-through wavelength is stopped, a new channel can be added at the ADD port. The card's second AWG multiplexes all of the wavelengths, and the aggregate signal is output through the COM-TX port." "The 40-WSS-C or 40-WSS-CE has eight types of ports: • ADD RX ports (1 to 40): These ports are used for adding channels. Each add channel is associated with an

	individual switch element that selects whether an individual channel is added. Each add port has optical power regulation provided by a VOA. The five connectors on the card faceplate accept MPO cables for the client input interfaces. MPO cables break out into eight separate cables. The 40-WSS-C or 40-WSS-CE card also has one LC-PC-II optical connector for the main input. • COM RX: The COM RX port receives the optical signal from a preamplifier (such as the OPT-PRE) and sends it to the optical splitter. • COM TX: The COM TX port sends an aggregate optical signal to a booster amplifier card (for example, the OPT-BST card) for transmission outside of the NE. • EXP RX port: The EXP RX port receives an optical signal from another 40-WSS-C or 40-WSS-CE card in the same NE. • EXP TX: The EXP TX port sends an optical signal to the other 40-WSS-C or 40-WSS-CE card within the NE. • DROP TX port: The DROP TX port sends the split off optical signal that contains drop channels to the 40-DMX-C(or 40-DMX-CE) card, where the channels are further processed and dropped. "The following figure shows a functional block diagram of the 40-WSS-C or 40-WSS-CE card: Figure 3: 40-WSS-C or 40-WSS-CE Block Diagram:" 

	According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide ROADM functionality as follows: "The 40-WSS-C (or 40-WSS-CE) card works in combination with the 40-DMX-C (or 40-DMX-CE) card to implement ROADM functionality. As a ROADM node, the node can be configured at the optical channel level using CTC, Cisco Transport Planner, and CTM. ROADM functionality using the 40-WSS-C (or 40-WSS-CE) card requires two 40-WSS-C (or 40-WSS-CE) double-slot cards and two 40-DMX-C (or 40-DMX-CE) single-slot cards (for a total of six slots in the chassis)." According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide power monitoring functionality as follows: "The 40-WSS-C (or 40-WSS-CE) has physical diodes that monitor power at various locations on the card. The following table lists the physical diode descriptions." According to Cisco's NCS 2000 Data Sheet 2, Cisco provides a ROADM as follows: "The Cisco 16-port Flex Spectrum ROADM Line Card (16-WXC-FS) is a double-slot unit that provides multidegree switching capabilities not only at the individual wavelength level but also with flexible spectrum allocations. You can use the 16-port Flex Spectrum ROADM Line Card in the core of the network to build ROADM nodes with 96 channels spaced at 50-GHz, FlexSpectrum channels, or a combination of the two. By using a simple software reconfiguration, the same unit can provide colorless multiplexing and demultiplexing to ROADM nodes." Figure 4 of Cisco's NCS 2000 Data Sheet 2 provides a picture of the "16-port Flex Spectrum ROADM Line Card N-Degree ROADM Layout," which includes several WSS devices:

	 Cisco's ONS 15454 Data Sheet also states that it's 40-WXC-C component in its ROADM devices use "MEMS," which are micro-electromechanical mirrors, to switch (route/add/drop/attenuate/etc.) the signals.
a) multiple fiber collimators, providing an input port for a multi-wavelength optical signal and a plurality of output ports;	The Cisco ROADMs include multiple fiber collimators, providing an input port for a multi-wavelength optical signal and a plurality of output ports. According to Cisco's Data Sheets and website, Cisco's ROADM products include a WSS-based card ("switching module"). The switching module includes multiple fiber collimators, providing an input for multi-wavelength optical signal and a plurality of output ports.
b) a wavelength-separator, for separating said multi-wavelength optical signal from said input port	The Cisco ROADMs include a wavelength separator, for separating multi-wavelength optical signal from said input port into multiple spectral channels.

into multiple spectral channels;	According to Cisco's Data Sheets and website, Cisco's ROADM products include a WSS-based card ("switching module"). The switching module includes a wavelength separator, for separating multi-wavelength optical signal from said input port into multiple spectral channels.
c) a beam-focuser, for focusing said spectral channels into corresponding spectral spots; and	The Cisco ROADMs include a beam-focuser, for focusing said spectral channels into corresponding spectral spots. According to Cisco's Data Sheets and website, Cisco's ROADM products include a WSS-based card ("switching module"). The switching module includes a beam-focuser, for focusing said spectral channels into corresponding spectral spots.
d) a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports.	The Cisco ROADMs include a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect said corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports. According to Cisco's Data Sheets and website, Cisco's ROADM products include a WSS-based card ("switching module"). The switching module includes a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect said corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports. According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide complete ROADM functionality and allow for the adding, dropping, multiplexing, switching, and routing of signals on an individual wavelength level. According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide ROADM functionality as follows: "The 40-WSS-C (or 40-WSS-CE) card works in combination with the 40-DMX-C (or 40-DMX-CE) card to implement ROADM functionality. As a ROADM node, the node can be configured at the optical channel level

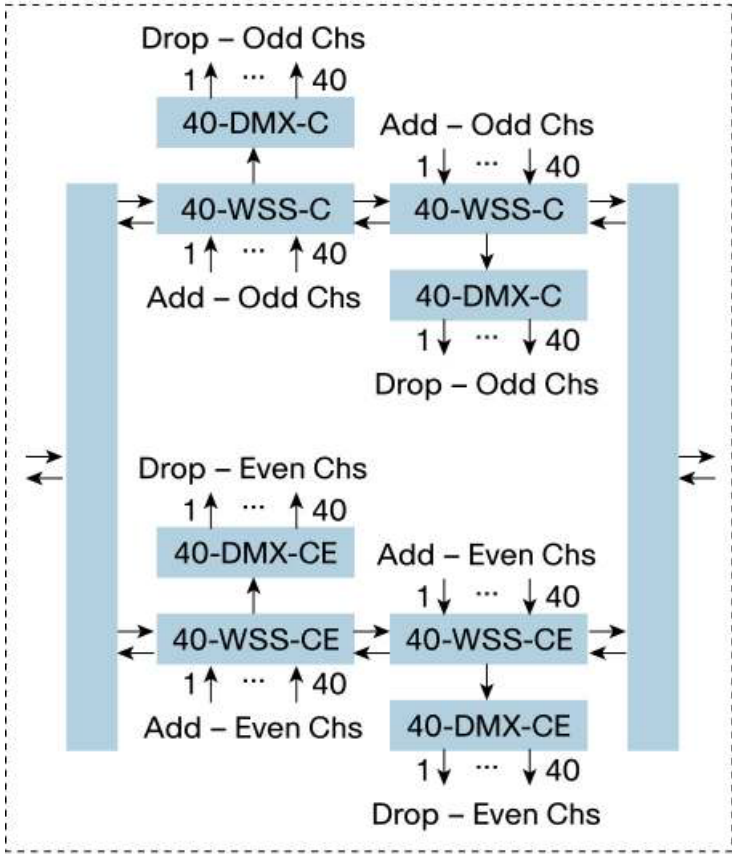
	using CTC, Cisco Transport Planner, and CTM. ROADM functionality using the 40-WSS-C (or 40-WSS-CE) card requires two 40-WSS-C (or 40-WSS-CE) double-slot cards and two 40-DMX-C (or 40-DMX-CE) single-slot cards (for a total of six slots in the chassis)." According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide power monitoring functionality as follows: "The 40-WSS-C (or 40-WSS-CE) has physical diodes that monitor power at various locations on the card. The following table lists the physical diode descriptions." Cisco's ONS 15454 Data Sheet also states that it's 40-WXC-C component in its ROADM devices use "MEMS," which are micro-electromechanical mirrors, to switch (route/add/drop/attenuate/etc.) the signals.
2. The wavelength-separating-routing apparatus of claim 1 further comprising a servo-control assembly, in communication with said channel micromirrors and said output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said output ports.	The Cisco ROADMs described in claim 1 further include a servo-control assembly, in communication with said channel micromirrors and said output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said output ports. As set forth in Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide "per-channel optical power monitoring using photodiodes" and "aggregate DWDM signal monitoring and control through a variable optical attenuator." In Cisco's ONS 15454 Data Sheet, Cisco describes the servo-control mechanism in its ROADM by explaining the dynamic control capabilities of its product as follows: "Embedded automatic power control mechanisms allow interfacing with different types of DWDM units without requiring external attenuators. Used in conjunction with Cisco ONS multiplexers and demultiplexers, these mechanisms allow the management of local add/drop traffic in the specific direction supported by the 80-WXC-C unit. "The Cisco ONS 15454 80-WXC-C card operates on the ITU 50-GHz wavelength plan. The card integrates automatic per-channel power monitor and control capabilities, providing node- and network-based automatic-power-level management on each input and output port. Per-channel optical path selection is also done in a completely automated way through Wavelength Path Provisioning (WPP) at the network level, featuring end-to-

	end, point-and-click wavelength provisioning and easy SONET/SDH-like wavelength management." Cisco's ONS 15454 Data Sheet also states that it's 40-WXC-C component in its ROADM devices use "MEMS," which are micro-electromechanical mirrors, to switch (route/add/drop/attenuate/etc.) the signals.
3. The wavelength-separating-routing apparatus of claim 2 wherein said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors.	The servo-control assembly of the Cisco ROADMs described in claim 2 further includes a spectral monitor for monitoring power levels of said spectral channels coupled into said output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors. As set forth in Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide "per-channel optical power monitoring using photodiodes" and "aggregate DWDM signal monitoring and control through a variable optical attenuator." In Cisco's ONS 15454 Data Sheet, Cisco describes the servo-control mechanism in its ROADM by explaining the dynamic control capabilities of its product as follows: "Embedded automatic power control mechanisms allow interfacing with different types of DWDM units without requiring external attenuators. Used in conjunction with Cisco ONS multiplexers and demultiplexers, these mechanisms allow the management of local add/drop traffic in the specific direction supported by the 80-WXC-C unit. "The Cisco ONS 15454 80-WXC-C card operates on the ITU 50-GHz wavelength plan. The card integrates automatic per-channel power monitor and control capabilities, providing node- and network-based automatic-power-level management on each input and output port. Per-channel optical path selection is also done in a completely automated way through Wavelength Path Provisioning (WPP) at the network level, featuring end-to-end, point-and-click wavelength provisioning and easy SONET/SDH-like wavelength management."
4. The wavelength-separating-routing apparatus of claim 3 wherein said servo-control assembly maintains said power levels at a predetermined value.	The servo-control assembly of the Cisco ROADMs described in claim 2 further maintains power levels at a predetermined value. As set forth in Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide "per-channel optical power monitoring using photodiodes" and "aggregate DWDM signal monitoring and control through a variable optical attenuator."

	In Cisco's ONS 15454 Data Sheet, Cisco describes the servo-control mechanism in its ROADM by explaining the dynamic control capabilities of its product as follows: "Embedded automatic power control mechanisms allow interfacing with different types of DWDM units without requiring external attenuators. Used in conjunction with Cisco ONS multiplexers and demultiplexers, these mechanisms allow the management of local add/drop traffic in the specific direction supported by the 80-WXC-C unit. "The Cisco ONS 15454 80-WXC-C card operates on the ITU 50-GHz wavelength plan. The card integrates automatic per-channel power monitor and control capabilities, providing node- and network-based automatic-power-level management on each input and output port. Per-channel optical path selection is also done in a completely automated way through Wavelength Path Provisioning (WPP) at the network level, featuring end-to-end, point-and-click wavelength provisioning and easy SONET/SDH-like wavelength management."
9. The wavelength-separating-routing apparatus of claim 1 wherein each channel micromirrors is continuously pivotable about one axis.	Cisco's ROADMs all include wavelength-separating-routing apparatus, wherein each channel micromirror is continuously pivotable about one axis. As set forth in Cisco's ONS 15454 Data Sheet, "[w]hile Wavelength Selective Switch (WSS) units provide degree-2 type reconfigurability (drop wavelength in a node vs. let it pass through the node), an ROADM node based on 40-WXC units can support up to degree-8 reconfigurability. This means that for each wavelength it is possible to decide if it has to be locally dropped or routed to any of the other 7 pass-through directions of the node. Such a capability not only enhances the flexibility of the DWDM transport network but also dramatically reduces the need for costly transponders to perform optical-to-electrical-to-optical conversion (typically 2 transponders/crossponders per add/drop channel or wavelength)." Cisco's ONS 15454 Data Sheet also states that it's 40-WXC-C component in its ROADM devices use "MEMS," which are micro-electromechanical mirrors, to switch (route/add/drop/attenuate/etc.) the signals.
10. The wavelength-separating-routing apparatus of claim 1 wherein each channel micromirror is pivotable about two axes.	Cisco's ROADMs all include wavelength-separating-routing apparatus, wherein each channel micromirror is continuously pivotable about two axes. As set forth in Cisco's ONS 15454 Data Sheet, "[w]hile Wavelength Selective Switch (WSS) units provide degree-2 type reconfigurability (drop wavelength in a node vs. let it pass through the node), an ROADM node

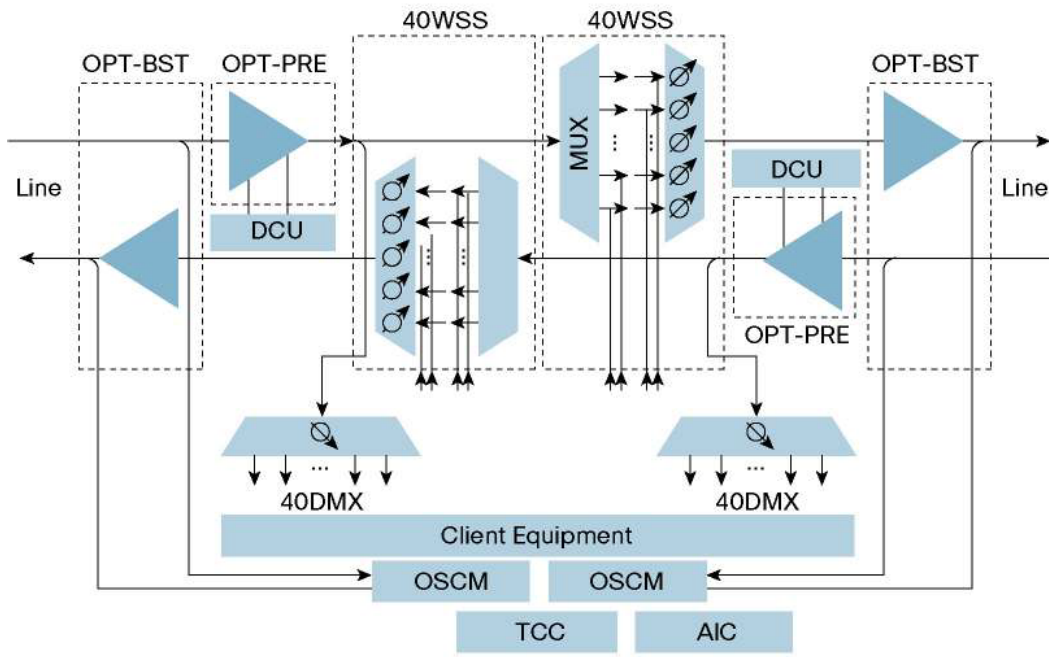
	based on 40-WXC units can support up to degree-8 reconfigurability. This means that for each wavelength it is possible to decide if it has to be locally dropped or routed to any of the other 7 pass-through directions of the node. Such a capability not only enhances the flexibility of the DWDM transport network but also dramatically reduces the need for costly transponders to perform optical-to-electrical-to-optical conversion (typically 2 transponders/crossponders per add/drop channel or wavelength)." Cisco's ONS 15454 Data Sheet also states that it's 40-WXC-C component in its ROADM devices use "MEMS," which are micro-electromechanical mirrors, to switch (route/add/drop/attenuate/etc.) the signals.
13. The wavelength-separating-routing apparatus of claim 1 wherein said fiber collimators are arranged in a one-dimensional array.	Cisco's ROADMs include wavelength-separating-routing apparatus of claim 1 that include fiber collimators that are arranged in a one-dimensional array. Cisco's ONS 15454 Data Sheet provides a picture of Cisco's ROADM devices. Within these devices, the fiber collimators can be arranged in a one-dimensional array:

	
17. The wavelength-separating-routing apparatus of claim 1 wherein said wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, halographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing gratings.	Cisco's ROADMs include switching modules that include diffraction gratings. The diffraction grating that Cisco uses in its ROADMs can be a ruled diffraction grating, an halographic diffraction grating, an echelle grating, a curved diffraction grating, or a dispersing grating.
19. The wavelength-separating-routing apparatus of claim 1	Cisco's ROADMs include output ports, which can be configured to carry only one wavelength or spectral channel.

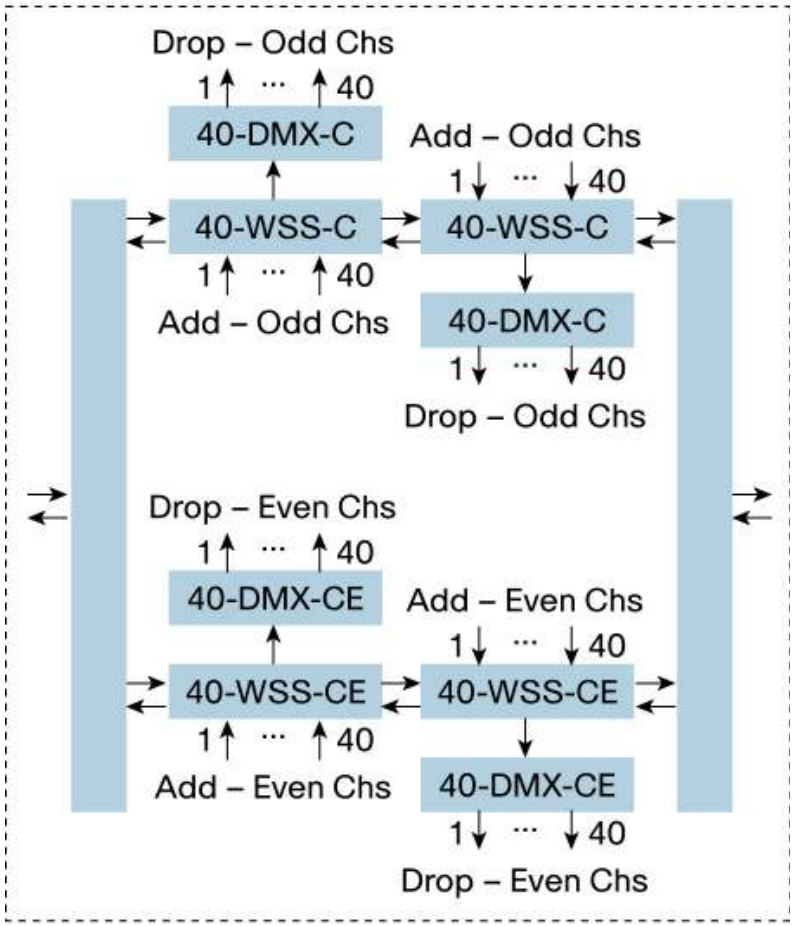
wherein each output port carries a single one of said spectral channels.	The following figure 4 from Cisco's ONS 15454 Data Sheet is a chart of the "MSTP 80-Channel Degree-2 ROADM Node" and shows that there are numerous output ports, and each output port can receive a single wavelength: 
20. The wavelength-separating-routing apparatus of claim 19 further comprising one or more optical sensors, optically coupled	Cisco's ROADMs include optical sensors that are optically coupled to said output ports. As set forth in Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide "per-channel optical power monitoring using photodiodes" and "aggregate DWDM signal monitoring and control through a variable optical

to said output ports.	attenuator."
21. A servo-based optical apparatus comprising:	Cisco makes, uses, sells, imports, and/or offers to sell reconfigurable optical add drop multiplexers ("ROADMs") and other products that incorporate wavelength selective switches ("WSSs"), each of which is a wavelength separating-routing apparatus. Several documents detail the functionality of Cisco's ROADM products, including: • "Data Sheet: 40-Channel Reconfigurable Optical Add/Drop Multiplexing Portfolio for the Cisco ONS 15454 Multiservice Transport Platform," dated 1992-2007 ("ONS 15454 Data Sheet"); • "Data Sheet: Cisco NCS 2000 Service Line Cards," dated 2013 ("NCS 2000 Data Sheet 1"); • "Data Sheet: Cisco Network Convergence System 2000 ROADM and Amplifier Line Cards," dated 2013 ("NCS 2000 Data Sheet 2"); • "Cisco ONS 15200 Series DWDM Systems," from Cisco's website (www.cisco.com/c/en/us/products/optical-networking/ons-15200-series-dwdm-systems/index.html) ("ONS 15200 Webpage"); • "Data Sheet: Cisco ONS 15216 C L-Band Splitter/Combiner Module for Cisco ONS 15454 MSTP" dated 1992-2005 ("ONS 15200 Data Sheet"); • "Cisco NCS 2002 and NCS 2006 Line Card Configuration Guide, Release 10.x.x," chapter titled "Provisioning Reconfigurable Optical Add/Drop Cards," which "describes the line cards deployed in reconfigurable optical add/drop (ROADM) networks," pp12-16, which focus on the "40-WSS-C and 40-WSS-CE Card," and pp 31-38, which focus on "Single Module ROADM (SMR-C) Cards" ("ROADM Configuration Chapter"); and • information and documents available from Cisco's website (www.cisco.com) ("Website"). According to Cisco's ONS 15454 Data Sheet: "The Cisco® ONS 15454 Multiservice Transport Platform (MSTP) (Figure 1) provides a comprehensive, intelligent dense wavelength-division multiplexing (DWDM) solution for expanding metropolitan (metro) and regional bandwidth." Figure 1 is labeled as "40-Channel Wavelength Cross-Connect (40-WXC), Wavelength Selective Switch (40-WSS), Multiplexer (40-MUX), and Demultiplexer (40-DMX) Units." "While Wavelength Selective Switch (WSS) units provide degree-2 type reconfigurability (drop wavelength in a

	node vs. let it pass through the node), an ROADM node based on 40-WXC units can support up to degree-8 reconfigurability. This means that for each wavelength it is possible to decide if it has to be locally dropped or routed to any of the other 7 pass-through directions of the node. Such a capability not only enhances the flexibility of the DWDM transport network but also dramatically reduces the need for costly transponders to perform optical-to-electrical-to-optical conversion (typically 2 transponders/crossponders per add/drop channel or wavelength)." "As even in complex mesh network topologies it is likely that degree-2 reconfigurability would be enough for most of the node, the 40-channel ROADM portfolio includes also two different versions of the 40-WSS units, one operating on the odd channels of the C band spectrum (40-WSS-C) and the other one operating on the even channels of the C band spectrum (40-WSS-CE). The units can be used in conjunction with existing 32-channel ROADM solutions and with 40-WXC units to provide the greatest degree of flexibility for Cisco ONS 15454 MSTP deployments." "Embedded automatic power control mechanisms feature the possibility to interface with different types of DWDM units without requiring external attenuators. Used in conjunction with the 40-channel Multiplexer and 40-channel Demultiplexer allows to manage local add/drop traffic of the specific direction supported by the 40-WXC unit." "Embedded automatic power control mechanisms feature the possibility to interface with different type of DWDM units without requiring external attenuators." A chart in Cisco's ONS 15454 Data Sheet lists the components within the 40-Channel ROADM Units, including a "40-Channel Wavelength Selective Switch" The following figure 3 from Cisco's ONS 15454 Data Sheet is a chart of the "MSTP 40-Channel Degree-2 ROADM Node" and shows how wavelength selective switches (labeled "WSS") are integrated within a Cisco's ROADM:



The following figure 4 from Cisco's ONS 15454 Data Sheet is a chart of the "MSTP 80-Channel Degree-2 ROADM Node" and shows how wavelength selective switches (labeled "WSS") are integrated within a Cisco's ROADM and how Cisco's ROADM can add and drop signals:

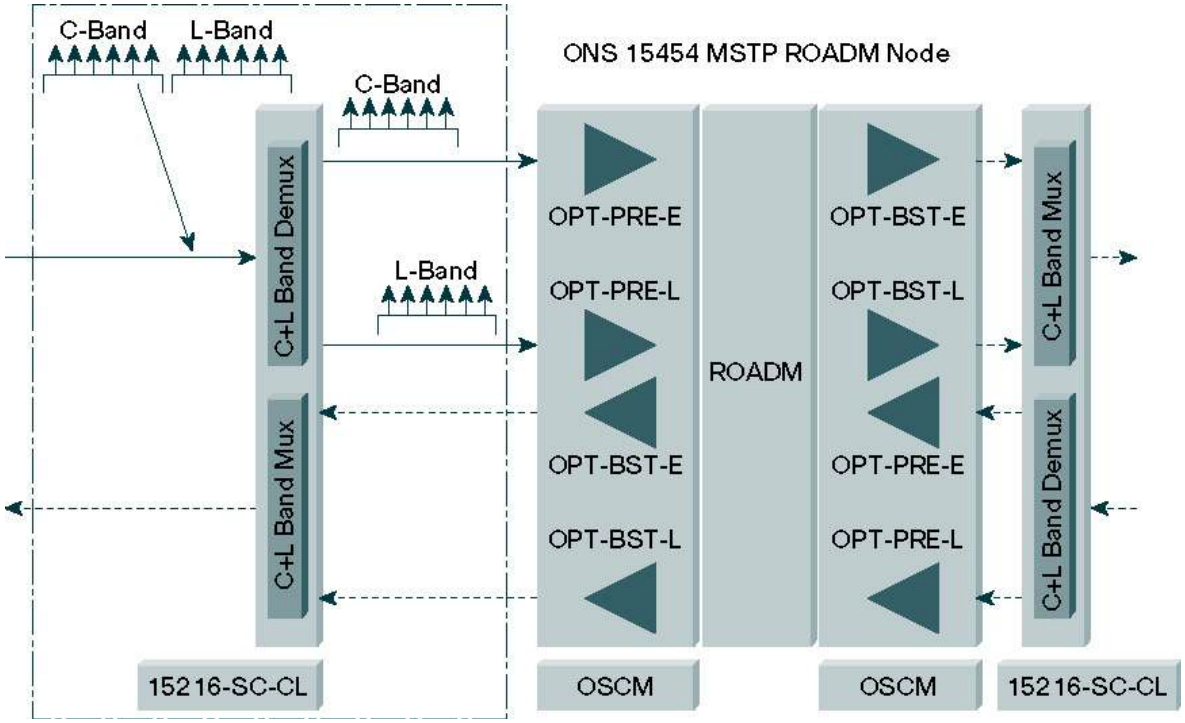


According to Cisco's ONS 15200 Data Sheet and ONS 15200 Webpage, both of which describe the ONS 15200 series of Cisco products, the ONS 15216 is the front end to the WSS ROADM in the ONS 15454. The ONS 15216 and ONS 15454 are integral to one another, so the ONS 15216 cannot work without the ONS 15454 and vice versa.

According to Cisco's ONS 15200 Webpage, "Cisco ONS 15200 Series DWDM Systems consist of intuitive,

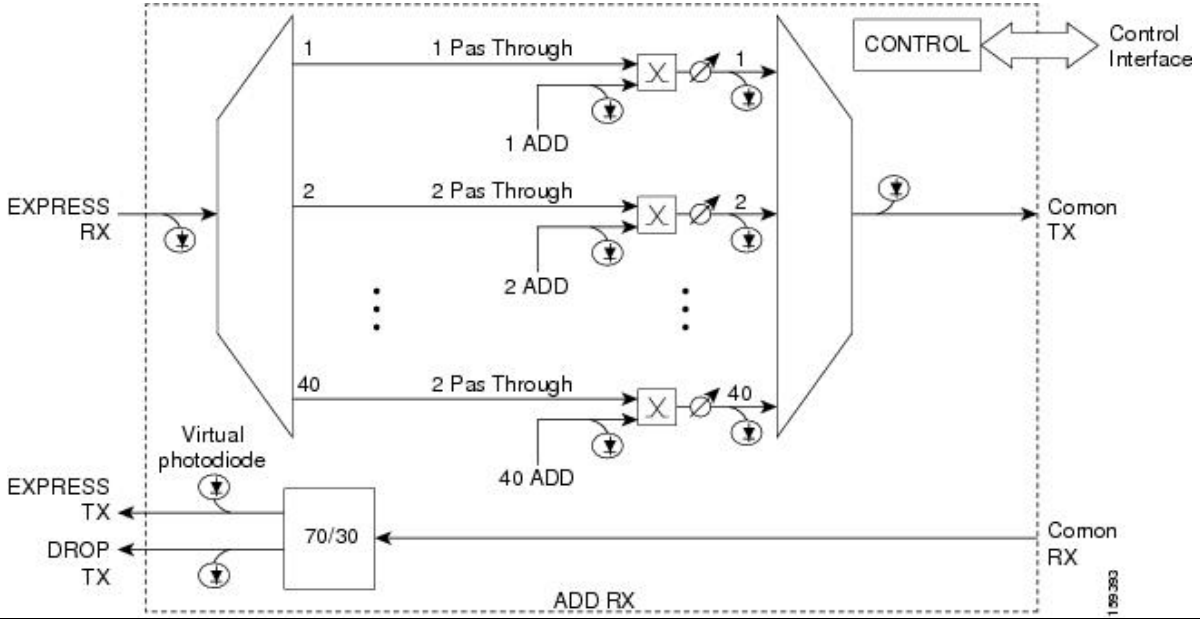
compact, passive devices used in a variety of applications. These range from low latency, point-to-point data center interconnect to passive or reconfigurable optical add/drop multiplexer- (ROADM) based metropolitan rings."

According to Cisco's ONS 15200 Data Sheet, Figure 3 describes "Cisco ONS 15216 C+L-Band Splitter/Combiner Module Deployed in a Cisco ONS 15454 MSTP ROADM Node" and depicts the relationship of Cisco's 15200 series products with Cisco's 15454 ROADM as follows:

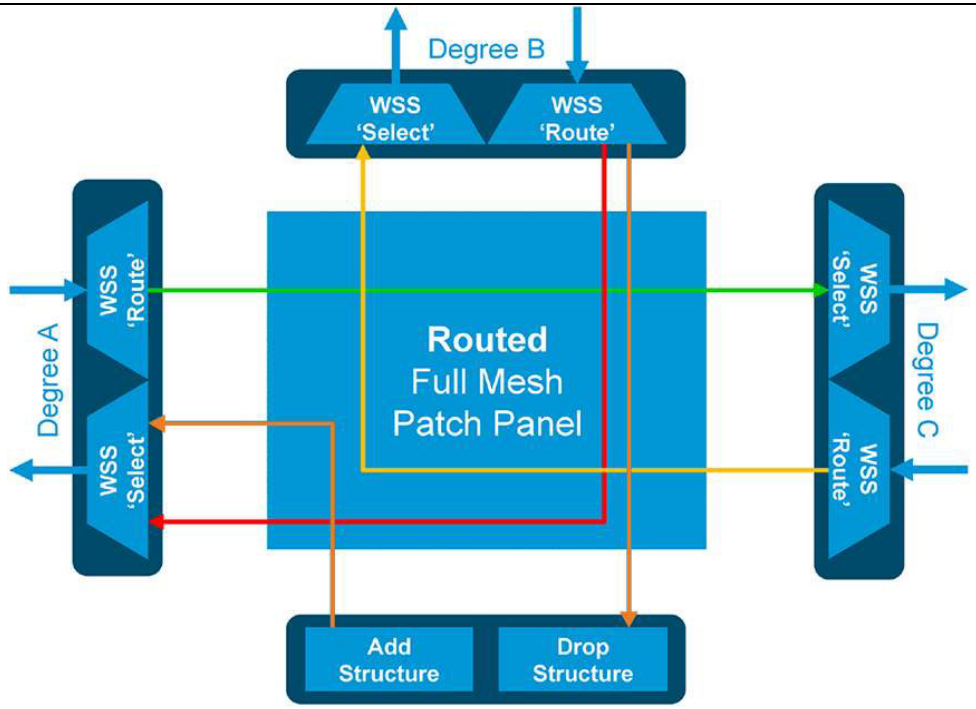


According to Cisco's ROADM Configuration Chapter, the Single Module ROADM (SMR-C) Cards are "single-slot 40-channel single module ROADM (SMR-C) cards" and they "integrate the following functional blocks onto a single line card:
"• Optical preamplifier
• Optical booster amplifier

	• Optical service channel (OSC) filter • 2x1 wavelength cross-connect (WXC) or a 4x1 WXC • Optical channel monitor (OCM)" According to Cisco's ROADM Configuration Chapter, the Single Module ROADM (SMR-C) Cards "can manage up to 40 channels spaced at 100GHz on each port." Cisco's ROADM Configuration Chapter about provisioning reconfigurable optical add/drop cards describes the "40-WSS-C and 40-WSS-CE Card" as follows: "The double-slot 40-channel wavelength selective switch C-band (40-WSS-C) or the double-slot 40-channel wavelength selective switch even-channel C-band (40-WSS-CE) card switches 40 ITU-T 100-GHz-spaced channels identified in the channel plan (Table 4: Channel Allocation Plan or Table 5: Channel Allocation Plan) and sends them to dedicated output ports. The 40-WSS-C or 40-WSS-CE card is bidirectional and optically passive. The card can be installed in Slots 1 to 6 and 12 to 17 "The 40-WSS-C or 40-WSS-CE features include: • Receipt of an aggregate DWDM signal into 40 output optical channels from the Line receive port (EXP RX) in one direction and from the COM-RX port in the other direction. • Per-channel optical power monitoring using photodiodes. • Signal splitting in a 70%-to-30% ratio, sent to the 40-DMX-C (or 40-DMX-CE) for dropping signals, then to the other 40-WSS-C (or 40-WSS-CE) card. • Aggregate DWDM signal monitoring and control through a variable optical attenuator (VOA). In the case of electrical power failure, the VOA is set to its maximum attenuation for safety purposes. A manual VOA setting is also available." "Within the 40-WSS-C or 40-WSS-CE card, the first AWG opens the spectrum and each wavelength is directed to one of the ports of a 1x2 optical switch. The same wavelength can be passed through or stopped. If the pass-through wavelength is stopped, a new channel can be added at the ADD port. The card's second AWG multiplexes all of the wavelengths, and the aggregate signal is output through the COM-TX port." "The 40-WSS-C or 40-WSS-CE has eight types of ports: • ADD RX ports (1 to 40): These ports are used for adding channels. Each add channel is associated with an

	individual switch element that selects whether an individual channel is added. Each add port has optical power regulation provided by a VOA. The five connectors on the card faceplate accept MPO cables for the client input interfaces. MPO cables break out into eight separate cables. The 40-WSS-C or 40-WSS-CE card also has one LC-PC-II optical connector for the main input. • COM RX: The COM RX port receives the optical signal from a preamplifier (such as the OPT-PRE) and sends it to the optical splitter. • COM TX: The COM TX port sends an aggregate optical signal to a booster amplifier card (for example, the OPT-BST card) for transmission outside of the NE. • EXP RX port: The EXP RX port receives an optical signal from another 40-WSS-C or 40-WSS-CE card in the same NE. • EXP TX: The EXP TX port sends an optical signal to the other 40-WSS-C or 40-WSS-CE card within the NE. • DROP TX port: The DROP TX port sends the split off optical signal that contains drop channels to the 40-DMX-C(or 40-DMX-CE) card, where the channels are further processed and dropped. "The following figure shows a functional block diagram of the 40-WSS-C or 40-WSS-CE card: Figure 3: 40-WSS-C or 40-WSS-CE Block Diagram:" 

	According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide ROADM functionality as follows: "The 40-WSS-C (or 40-WSS-CE) card works in combination with the 40-DMX-C (or 40-DMX-CE) card to implement ROADM functionality. As a ROADM node, the node can be configured at the optical channel level using CTC, Cisco Transport Planner, and CTM. ROADM functionality using the 40-WSS-C (or 40-WSS-CE) card requires two 40-WSS-C (or 40-WSS-CE) double-slot cards and two 40-DMX-C (or 40-DMX-CE) single-slot cards (for a total of six slots in the chassis)." According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide power monitoring functionality as follows: "The 40-WSS-C (or 40-WSS-CE) has physical diodes that monitor power at various locations on the card. The following table lists the physical diode descriptions." According to Cisco's NCS 2000 Data Sheet 2, Cisco provides a ROADM as follows: "The Cisco 16-port Flex Spectrum ROADM Line Card (16-WXC-FS) is a double-slot unit that provides multidegree switching capabilities not only at the individual wavelength level but also with flexible spectrum allocations. You can use the 16-port Flex Spectrum ROADM Line Card in the core of the network to build ROADM nodes with 96 channels spaced at 50-GHz, FlexSpectrum channels, or a combination of the two. By using a simple software reconfiguration, the same unit can provide colorless multiplexing and demultiplexing to ROADM nodes." Figure 4 of Cisco's NCS 2000 Data Sheet 2 provides a picture of the "16-port Flex Spectrum ROADM Line Card N-Degree ROADM Layout," which includes several WSS devices:

	 Cisco's ONS 15454 Data Sheet also states that it's 40-WXC-C component in its ROADM devices use "MEMS," which are micro-electromechanical mirrors, to switch (route/add/drop/attenuate/etc.) the signals.
a) multiple fiber collimators, providing an input port for a multi-wavelength optical signal and a plurality of output ports;	The Cisco ROADMs include multiple fiber collimators, providing an input port for a multi-wavelength optical signal and a plurality of output ports. According to Cisco's Data Sheets and website, Cisco's ROADM products include a WSS-based card ("switching module"). The switching module includes multiple fiber collimators, providing an input for multi-wavelength optical signal and a plurality of output ports.
b) a wavelength-separator, for separating said multi-wavelength	The Cisco ROADMs include a wavelength separator, for separating multi-wavelength optical signal from said input port into multiple spectral channels.

optical signal from said input port into multiple spectral channels;	According to Cisco's Data Sheets and website, Cisco's ROADM products include a WSS-based card ("switching module"). The switching module includes a wavelength separator, for separating multi-wavelength optical signal from said input port into multiple spectral channels.
c) a beam focuser, for focusing said spectral channels into corresponding spectral spots; and	The Cisco ROADMs include a beam-focuser, for focusing said spectral channels into corresponding spectral spots. According to Cisco's Data Sheets and website, Cisco's ROADM products include a WSS-based card ("switching module"). The switching module includes a beam-focuser, for focusing said spectral channels into corresponding spectral spots.
d) a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being individually controllable to reflect said spectral channels into selected ones of said output ports; and	The Cisco ROADMs include a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being individually controllable to reflect said spectral channels into selected ones of said output ports. According to Cisco's Data Sheets and website, Cisco's ROADM products include a WSS-based card ("switching module"). The switching module includes a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect said corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports. According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide complete ROADM functionality and allow for the adding, dropping, multiplexing, switching, and routing of signals on an individual wavelength level. According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide ROADM functionality as follows: "The 40-WSS-C (or 40-WSS-CE) card works in combination with the 40-DMX-C (or 40-DMX-CE) card to implement ROADM functionality. As a ROADM node, the node can be configured at the optical channel level using CTC, Cisco Transport Planner, and CTM. ROADM functionality using the 40-WSS-C (or 40-WSS-CE)

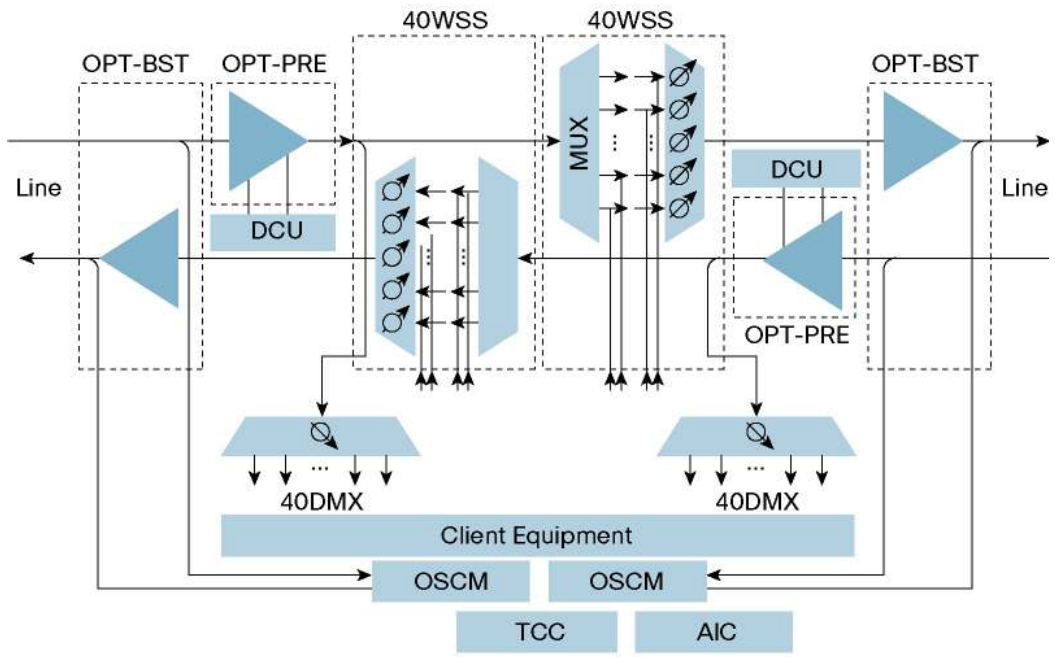
	card requires two 40-WSS-C (or 40-WSS-CE) double-slot cards and two 40-DMX-C (or 40-DMX-CE) single-slot cards (for a total of six slots in the chassis)." According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide power monitoring functionality as follows: "The 40-WSS-C (or 40-WSS-CE) has physical diodes that monitor power at various locations on the card. The following table lists the physical diode descriptions."
e) a servo-control assembly, in communication with said channel micromirrors and said output ports, for maintaining a predetermined coupling of each reflected spectral channel into one of said output ports.	The Cisco ROADMs include a servo-control assembly, in communication with said channel micromirrors and said output ports, for maintaining a predetermined coupling of each reflected spectral channel into one of said output ports. As set forth in Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide "per-channel optical power monitoring using photodiodes" and "aggregate DWDM signal monitoring and control through a variable optical attenuator." In Cisco's ONS 15454 Data Sheet, Cisco describes the servo-control mechanism in its ROADM by explaining the dynamic control capabilities of its product as follows: "Embedded automatic power control mechanisms allow interfacing with different types of DWDM units without requiring external attenuators. Used in conjunction with Cisco ONS multiplexers and demultiplexers, these mechanisms allow the management of local add/drop traffic in the specific direction supported by the 80-WXC-C unit. "The Cisco ONS 15454 80-WXC-C card operates on the ITU 50-GHz wavelength plan. The card integrates automatic per-channel power monitor and control capabilities, providing node- and network-based automatic-power-level management on each input and output port. Per-channel optical path selection is also done in a completely automated way through Wavelength Path Provisioning (WPP) at the network level, featuring end-to-end, point-and-click wavelength provisioning and easy SONET/SDH-like wavelength management."
22. The servo-based optical apparatus of claim 21 wherein	The servo-control assembly of Cisco's ROADMs described in claim 21 further includes a spectral monitor for monitoring power levels of said spectral channels coupled into said output ports, and a processing unit

said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors.	responsive to said power levels for providing control of said channel micromirrors. As set forth in Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide "per-channel optical power monitoring using photodiodes" and "aggregate DWDM signal monitoring and control through a variable optical attenuator." In Cisco's ONS 15454 Data Sheet, Cisco describes the servo-control mechanism in its ROADM by explaining the dynamic control capabilities of its product as follows: "Embedded automatic power control mechanisms allow interfacing with different types of DWDM units without requiring external attenuators. Used in conjunction with Cisco ONS multiplexers and demultiplexers, these mechanisms allow the management of local add/drop traffic in the specific direction supported by the 80-WXC-C unit. "The Cisco ONS 15454 80-WXC-C card operates on the ITU 50-GHz wavelength plan. The card integrates automatic per-channel power monitor and control capabilities, providing node- and network-based automatic-power-level management on each input and output port. Per-channel optical path selection is also done in a completely automated way through Wavelength Path Provisioning (WPP) at the network level, featuring end-to-end, point-and-click wavelength provisioning and easy SONET/SDH-like wavelength management."
23. The servo-based optical apparatus of claim 22 wherein said servo-control assembly maintains said power levels at a predetermined value.	The servo-control assembly of Cisco's ROADMs described in claim 21 further maintains power levels at a predetermined value. As set forth in Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide "per-channel optical power monitoring using photodiodes" and "aggregate DWDM signal monitoring and control through a variable optical attenuator." In Cisco's ONS 15454 Data Sheet, Cisco describes the servo-control mechanism in its ROADM by explaining the dynamic control capabilities of its product as follows: "Embedded automatic power control mechanisms allow interfacing with different types of DWDM units without requiring external attenuators. Used in conjunction with Cisco ONS multiplexers and demultiplexers, these mechanisms allow the management of local add/drop traffic in the specific direction supported by the 80-WXC-

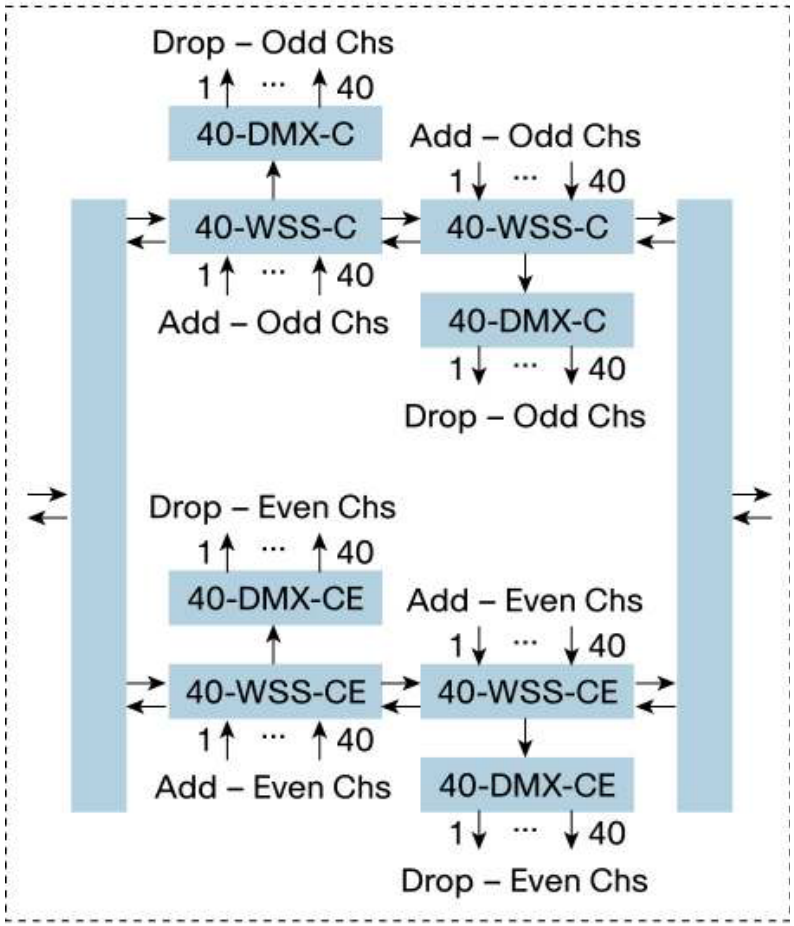
	C unit. "The Cisco ONS 15454 80-WXC-C card operates on the ITU 50-GHz wavelength plan. The card integrates automatic per-channel power monitor and control capabilities, providing node- and network-based automatic-power-level management on each input and output port. Per-channel optical path selection is also done in a completely automated way through Wavelength Path Provisioning (WPP) at the network level, featuring end-to-end, point-and-click wavelength provisioning and easy SONET/SDH-like wavelength management."
27. The servo-based optical apparatus of claim 21 wherein each channel micromirror is continuously pivotable about at least one axis.	Cisco's ROADMs include MEMs ("micro electro mechanical") elements, wherein each channel micromirror is continuously pivotable about one axis. As set forth in Cisco's ONS 15454 Data Sheet, "[w]hile Wavelength Selective Switch (WSS) units provide degree-2 type reconfigurability (drop wavelength in a node vs. let it pass through the node), an ROADM node based on 40-WXC units can support up to degree-8 reconfigurability. This means that for each wavelength it is possible to decide if it has to be locally dropped or routed to any of the other 7 pass-through directions of the node. Such a capability not only enhances the flexibility of the DWDM transport network but also dramatically reduces the need for costly transponders to perform optical-to-electrical-to-optical conversion (typically 2 transponders/crossponders per add/drop channel or wavelength)." Cisco's ONS 15454 Data Sheet also states that it's 40-WXC-C component in its ROADM devices use "MEMS," which are micro-electromechanical mirrors, to switch (route/add/drop/attenuate/etc.) the signals.
29. The servo-based optical apparatus of claim 21 wherein said wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms.	Cisco's ROADMs include switch modules that include diffraction gratings. The diffraction grating that Cisco uses in its ROADMs can be a ruled diffraction grating, an halographic diffraction grating, an echelle grating, a curved diffraction grating, or a dispersing grating.
44. An optical system comprising	Cisco makes, uses, sells, imports, and/or offers to sell reconfigurable optical add drop multiplexers

a wavelength-separating-routing apparatus, wherein said wavelength-separating-routing apparatus includes:	("ROADMs") and other products that incorporate wavelength selective switches ("WSSs"), each of which is a wavelength separating-routing apparatus. Several documents detail the functionality of Cisco's ROADM products, including: • "Data Sheet: 40-Channel Reconfigurable Optical Add/Drop Multiplexing Portfolio for the Cisco ONS 15454 Multiservice Transport Platform," dated 1992-2007 ("ONS 15454 Data Sheet"); • "Data Sheet: Cisco NCS 2000 Service Line Cards," dated 2013 ("NCS 2000 Data Sheet 1"); • "Data Sheet: Cisco Network Convergence System 2000 ROADM and Amplifier Line Cards," dated 2013 ("NCS 2000 Data Sheet 2"); • "Cisco ONS 15200 Series DWDM Systems," from Cisco's website (www.cisco.com/c/en/us/products/optical-networking/ons-15200-series-dwdm-systems/index.html) ("ONS 15200 Webpage"); • "Data Sheet: Cisco ONS 15216 C L-Band Splitter/Combiner Module for Cisco ONS 15454 MSTP" dated 1992-2005 ("ONS 15200 Data Sheet"); • "Cisco NCS 2002 and NCS 2006 Line Card Configuration Guide, Release 10.x.x," chapter titled "Provisioning Reconfigurable Optical Add/Drop Cards," which "describes the line cards deployed in reconfigurable optical add/drop (ROADM) networks," pp12-16, which focus on the "40-WSS-C and 40-WSS-CE Card," and pp 31-38, which focus on "Single Module ROADM (SMR-C) Cards" ("ROADM Configuration Chapter"); and • information and documents available from Cisco's website (www.cisco.com) ("Website"). According to Cisco's ONS 15454 Data Sheet: "The Cisco® ONS 15454 Multiservice Transport Platform (MSTP) (Figure 1) provides a comprehensive, intelligent dense wavelength-division multiplexing (DWDM) solution for expanding metropolitan (metro) and regional bandwidth." Figure 1 is labeled as "40-Channel Wavelength Cross-Connect (40-WXC), Wavelength Selective Switch (40-WSS), Multiplexer (40-MUX), and Demultiplexer (40-DMX) Units." "While Wavelength Selective Switch (WSS) units provide degree-2 type reconfigurability (drop wavelength in a node vs. let it pass through the node), an ROADM node based on 40-WXC units can support up to degree-8 reconfigurability. This means that for each wavelength it is possible to decide if it has to be locally dropped or routed to any of the other 7 pass-through directions of the node. Such a capability not only enhances the

	flexibility of the DWDM transport network but also dramatically reduces the need for costly transponders to perform optical-to-electrical-to-optical conversion (typically 2 transponders/crossponders per add/drop channel or wavelength)." "As even in complex mesh network topologies it is likely that degree-2 reconfigurability would be enough for most of the node, the 40-channel ROADM portfolio includes also two different versions of the 40-WSS units, one operating on the odd channels of the C band spectrum (40-WSS-C) and the other one operating on the even channels of the C band spectrum (40-WSS-CE). The units can be used in conjunction with existing 32-channel ROADM solutions and with 40-WXC units to provide the greatest degree of flexibility for Cisco ONS 15454 MSTP deployments." "Embedded automatic power control mechanisms feature the possibility to interface with different types of DWDM units without requiring external attenuators. Used in conjunction with the 40-channel Multiplexer and 40-channel Demultiplexer allows to manage local add/drop traffic of the specific direction supported by the 40-WXC unit." "Embedded automatic power control mechanisms feature the possibility to interface with different type of DWDM units without requiring external attenuators." A chart in Cisco's ONS 15454 Data Sheet lists the components within the 40-Channel ROADM Units, including a "40-Channel Wavelength Selective Switch" The following figure 3 from Cisco's ONS 15454 Data Sheet is a chart of the "MSTP 40-Channel Degree-2 ROADM Node" and shows how wavelength selective switches (labeled "WSS") are integrated within a Cisco's ROADM:



The following figure 4 from Cisco's ONS 15454 Data Sheet is a chart of the "MSTP 80-Channel Degree-2 ROADM Node" and shows how wavelength selective switches (labeled "WSS") are integrated within a Cisco's ROADM and how Cisco's ROADM can add and drop signals:

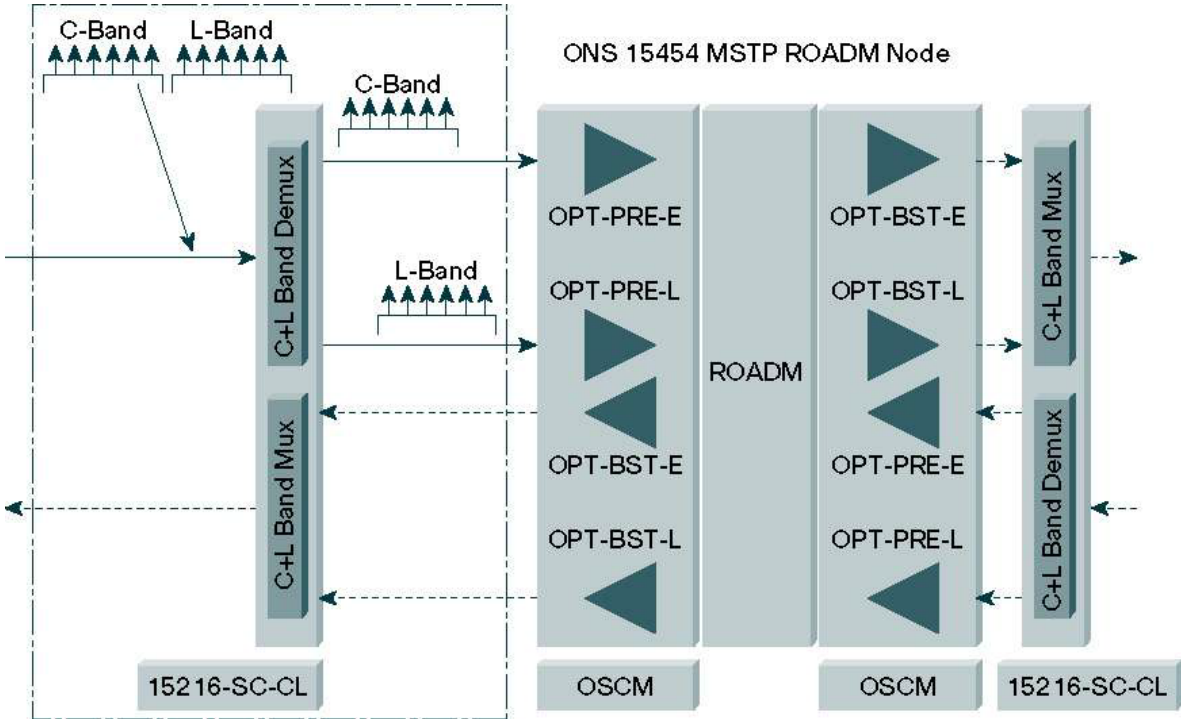


According to Cisco's ONS 15200 Data Sheet and ONS 15200 Webpage, both of which describe the ONS 15200 series of Cisco products, the ONS 15216 is the front end to the WSS ROADM in the ONS 15454. The ONS 15216 and ONS 15454 are integral to one another, so the ONS 15216 cannot work without the ONS 15454 and vice versa.

According to Cisco's ONS 15200 Webpage, "Cisco ONS 15200 Series DWDM Systems consist of intuitive,

compact, passive devices used in a variety of applications. These range from low latency, point-to-point data center interconnect to passive or reconfigurable optical add/drop multiplexer- (ROADM) based metropolitan rings."

According to Cisco's ONS 15200 Data Sheet, Figure 3 describes "Cisco ONS 15216 C+L-Band Splitter/Combiner Module Deployed in a Cisco ONS 15454 MSTP ROADM Node" and depicts the relationship of Cisco's 15200 series products with Cisco's 15454 ROADM as follows:

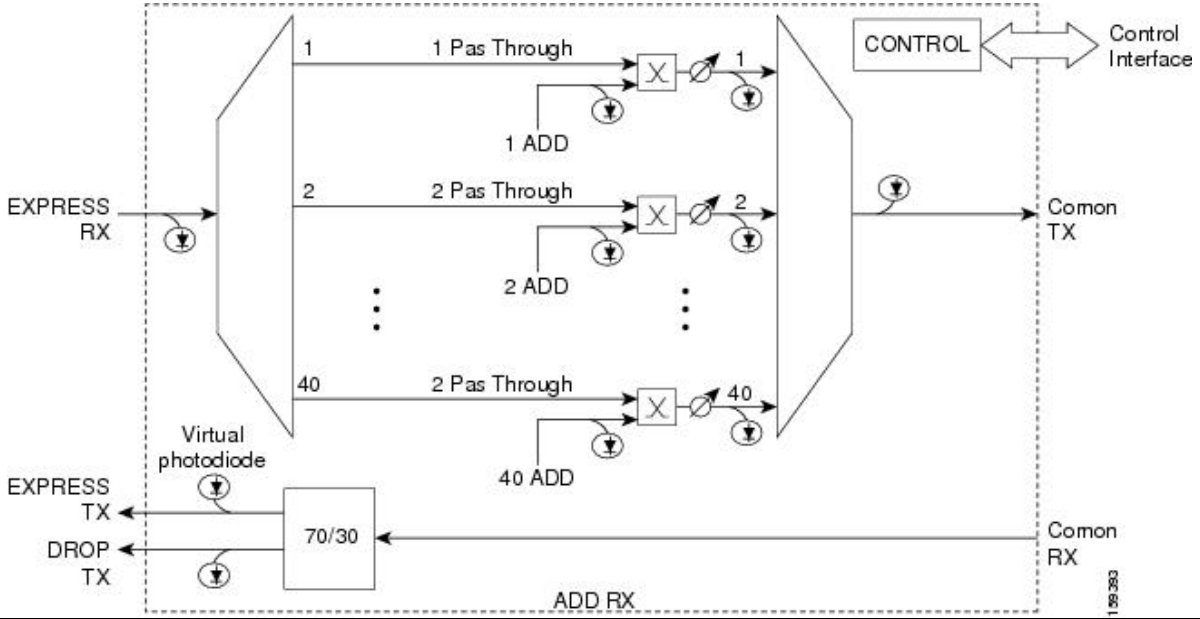


According to Cisco's ROADM Configuration Chapter, the Single Module ROADM (SMR-C) Cards are "single-slot 40-channel single module ROADM (SMR-C) cards" and they "integrate the following functional blocks onto a single line card:

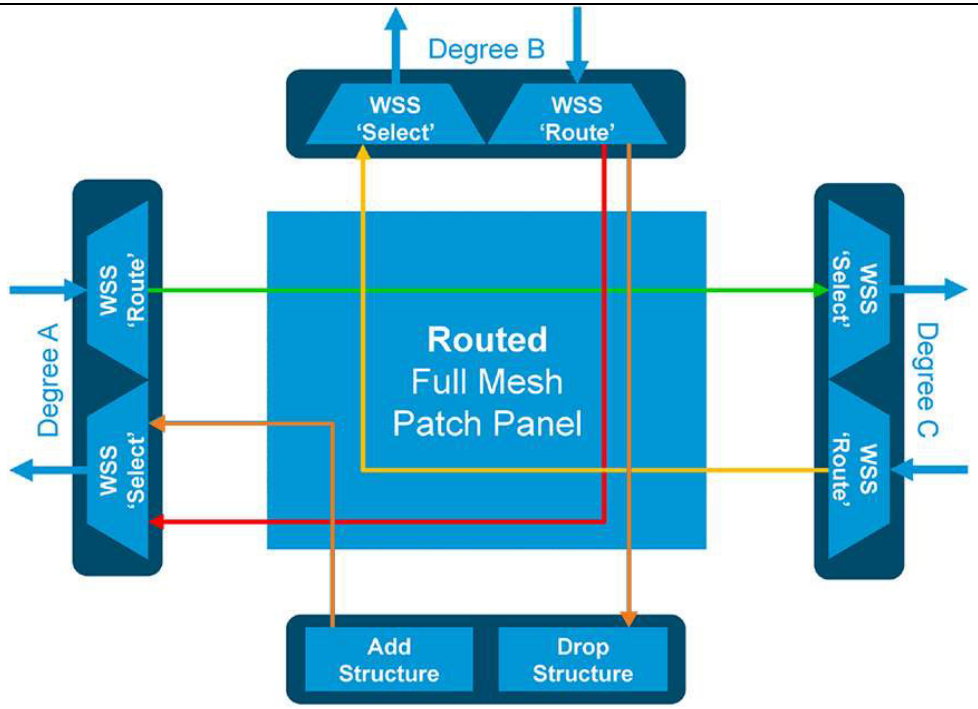
"• Optical preamplifier

• Optical booster amplifier

	• Optical service channel (OSC) filter • 2x1 wavelength cross-connect (WXC) or a 4x1 WXC • Optical channel monitor (OCM)" According to Cisco's ROADM Configuration Chapter, the Single Module ROADM (SMR-C) Cards "can manage up to 40 channels spaced at 100GHz on each port." Cisco's ROADM Configuration Chapter about provisioning reconfigurable optical add/drop cards describes the "40-WSS-C and 40-WSS-CE Card" as follows: "The double-slot 40-channel wavelength selective switch C-band (40-WSS-C) or the double-slot 40-channel wavelength selective switch even-channel C-band (40-WSS-CE) card switches 40 ITU-T 100-GHz-spaced channels identified in the channel plan (Table 4: Channel Allocation Plan or Table 5: Channel Allocation Plan) and sends them to dedicated output ports. The 40-WSS-C or 40-WSS-CE card is bidirectional and optically passive. The card can be installed in Slots 1 to 6 and 12 to 17 "The 40-WSS-C or 40-WSS-CE features include: • Receipt of an aggregate DWDM signal into 40 output optical channels from the Line receive port (EXP RX) in one direction and from the COM-RX port in the other direction. • Per-channel optical power monitoring using photodiodes. • Signal splitting in a 70%-to-30% ratio, sent to the 40-DMX-C (or 40-DMX-CE) for dropping signals, then to the other 40-WSS-C (or 40-WSS-CE) card. • Aggregate DWDM signal monitoring and control through a variable optical attenuator (VOA). In the case of electrical power failure, the VOA is set to its maximum attenuation for safety purposes. A manual VOA setting is also available." "Within the 40-WSS-C or 40-WSS-CE card, the first AWG opens the spectrum and each wavelength is directed to one of the ports of a 1x2 optical switch. The same wavelength can be passed through or stopped. If the pass-through wavelength is stopped, a new channel can be added at the ADD port. The card's second AWG multiplexes all of the wavelengths, and the aggregate signal is output through the COM-TX port." "The 40-WSS-C or 40-WSS-CE has eight types of ports: • ADD RX ports (1 to 40): These ports are used for adding channels. Each add channel is associated with an

	individual switch element that selects whether an individual channel is added. Each add port has optical power regulation provided by a VOA. The five connectors on the card faceplate accept MPO cables for the client input interfaces. MPO cables break out into eight separate cables. The 40-WSS-C or 40-WSS-CE card also has one LC-PC-II optical connector for the main input. • COM RX: The COM RX port receives the optical signal from a preamplifier (such as the OPT-PRE) and sends it to the optical splitter. • COM TX: The COM TX port sends an aggregate optical signal to a booster amplifier card (for example, the OPT-BST card) for transmission outside of the NE. • EXP RX port: The EXP RX port receives an optical signal from another 40-WSS-C or 40-WSS-CE card in the same NE. • EXP TX: The EXP TX port sends an optical signal to the other 40-WSS-C or 40-WSS-CE card within the NE. • DROP TX port: The DROP TX port sends the split off optical signal that contains drop channels to the 40-DMX-C(or 40-DMX-CE) card, where the channels are further processed and dropped. "The following figure shows a functional block diagram of the 40-WSS-C or 40-WSS-CE card: Figure 3: 40-WSS-C or 40-WSS-CE Block Diagram:" 

	According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide ROADM functionality as follows: "The 40-WSS-C (or 40-WSS-CE) card works in combination with the 40-DMX-C (or 40-DMX-CE) card to implement ROADM functionality. As a ROADM node, the node can be configured at the optical channel level using CTC, Cisco Transport Planner, and CTM. ROADM functionality using the 40-WSS-C (or 40-WSS-CE) card requires two 40-WSS-C (or 40-WSS-CE) double-slot cards and two 40-DMX-C (or 40-DMX-CE) single-slot cards (for a total of six slots in the chassis)." According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide power monitoring functionality as follows: "The 40-WSS-C (or 40-WSS-CE) has physical diodes that monitor power at various locations on the card. The following table lists the physical diode descriptions." According to Cisco's NCS 2000 Data Sheet 2, Cisco provides a ROADM as follows: "The Cisco 16-port Flex Spectrum ROADM Line Card (16-WXC-FS) is a double-slot unit that provides multidegree switching capabilities not only at the individual wavelength level but also with flexible spectrum allocations. You can use the 16-port Flex Spectrum ROADM Line Card in the core of the network to build ROADM nodes with 96 channels spaced at 50-GHz, FlexSpectrum channels, or a combination of the two. By using a simple software reconfiguration, the same unit can provide colorless multiplexing and demultiplexing to ROADM nodes." Figure 4 of Cisco's NCS 2000 Data Sheet 2 provides a picture of the "16-port Flex Spectrum ROADM Line Card N-Degree ROADM Layout," which includes several WSS devices:

	 Cisco's ONS 15454 Data Sheet also states that it's 40-WXC-C component in its ROADM devices use "MEMS," which are micro-electromechanical mirrors, to switch (route/add/drop/attenuate/etc.) the signals.
a) an array of fiber collimators, providing an input port for a multi-wavelength optical signal and a plurality of output ports including a pass-through port and one or more drop ports;	The Cisco ROADMs include multiple fiber collimators, providing an input port for a multi -wavelength optical signal and a plurality of output ports. According to Cisco's Data Sheets and website, Cisco's ROADM products include a WSS-based card ("switching module"). The switching module includes multiple fiber collimators, providing an input for multi-wavelength optical signal and a plurality of output ports.
b) a wavelength-separator, for separating said multi-wavelength optical signal from said input port	The Cisco ROADMs include a wavelength separator, for separating multi-wavelength optical signal from said input port into multiple spectral channels.

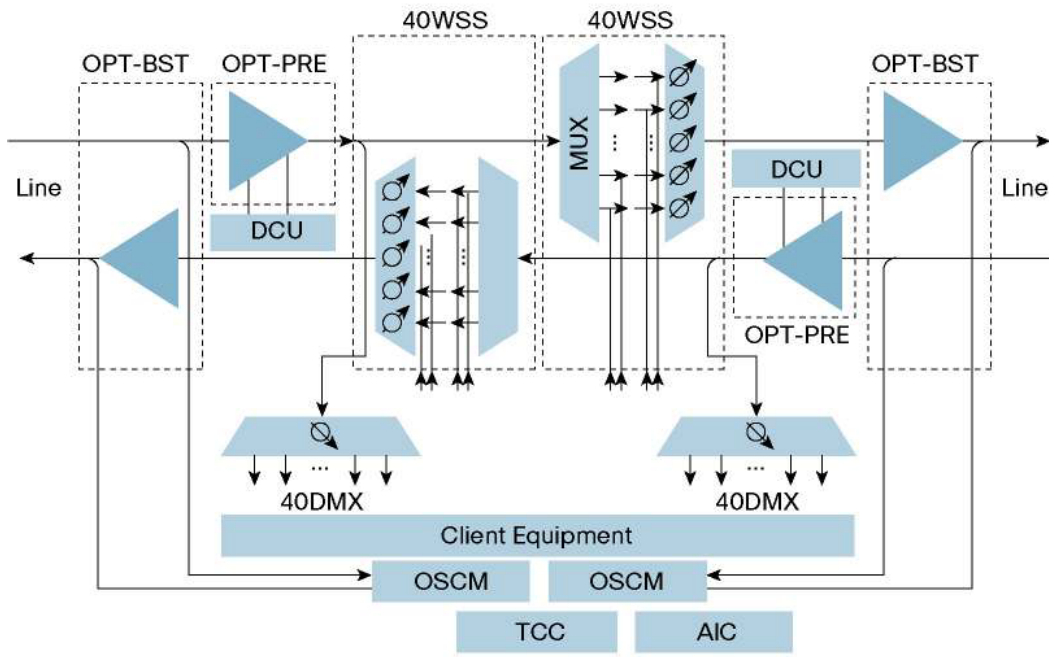
into multiple spectral channels;	According to Cisco's Data Sheets and website, Cisco's ROADM products include a WSS-based card ("switching module"). The switching module includes multiple fiber collimators, providing an input for multi-wavelength optical signal and a plurality of output ports.
c) a beam-focuser, for focusing said spectral channels into corresponding spectral spots; and	The Cisco ROADMs include a beam-focuser, for focusing said spectral channels into corresponding spectral spots. According to Cisco's Data Sheets and website, Cisco's ROADM products include a WSS-based card ("switching module"). The switching module includes a beam-focuser, for focusing said spectral channels into corresponding spectral spots.
d) a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports, whereby said pass-through port receives a subset of said spectral channels.	The Cisco ROADMs include a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports, whereby said pass-through port receives a subset of said spectral channels. According to Cisco's Data Sheets and website, Cisco's ROADM products include a WSS-based card ("switching module"). The switching module includes a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect said corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports. According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide complete ROADM functionality and allow for the adding, dropping, multiplexing, switching, and routing of signals on an individual wavelength level. According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide ROADM functionality as follows: "The 40-WSS-C (or 40-WSS-CE) card works in combination with the 40-DMX-C (or 40-DMX-CE) card to implement ROADM functionality. As a ROADM node, the node can be configured at the optical channel level

	using CTC, Cisco Transport Planner, and CTM. ROADM functionality using the 40-WSS-C (or 40-WSS-CE) card requires two 40-WSS-C (or 40-WSS-CE) double-slot cards and two 40-DMX-C (or 40-DMX-CE) single-slot cards (for a total of six slots in the chassis)." According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide power monitoring functionality as follows: "The 40-WSS-C (or 40-WSS-CE) has physical diodes that monitor power at various locations on the card. The following table lists the physical diode descriptions." Cisco's ONS 15454 Data Sheet also states that it's 40-WXC-C component in its ROADM devices use "MEMS," which are micro-electromechanical mirrors, to switch (route/add/drop/attenuate/etc.) the signals.
45. The optical system of claim 44 further comprising a servo-control assembly, in communication with said channel micromirrors and said output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said output ports.	The Cisco ROADMs described in claim 44 further include a servo-control assembly, in communication with said channel micromirrors and said output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said output ports. As set forth in Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide "per-channel optical power monitoring using photodiodes" and "aggregate DWDM signal monitoring and control through a variable optical attenuator." In Cisco's ONS 15454 Data Sheet, Cisco describes the servo-control mechanism in its ROADM by explaining the dynamic control capabilities of its product as follows: "Embedded automatic power control mechanisms allow interfacing with different types of DWDM units without requiring external attenuators. Used in conjunction with Cisco ONS multiplexers and demultiplexers, these mechanisms allow the management of local add/drop traffic in the specific direction supported by the 80-WXC-C unit. "The Cisco ONS 15454 80-WXC-C card operates on the ITU 50-GHz wavelength plan. The card integrates automatic per-channel power monitor and control capabilities, providing node- and network-based automatic-power-level management on each input and output port. Per-channel optical path selection is also done in a completely automated way through Wavelength Path Provisioning (WPP) at the network level, featuring end-to-

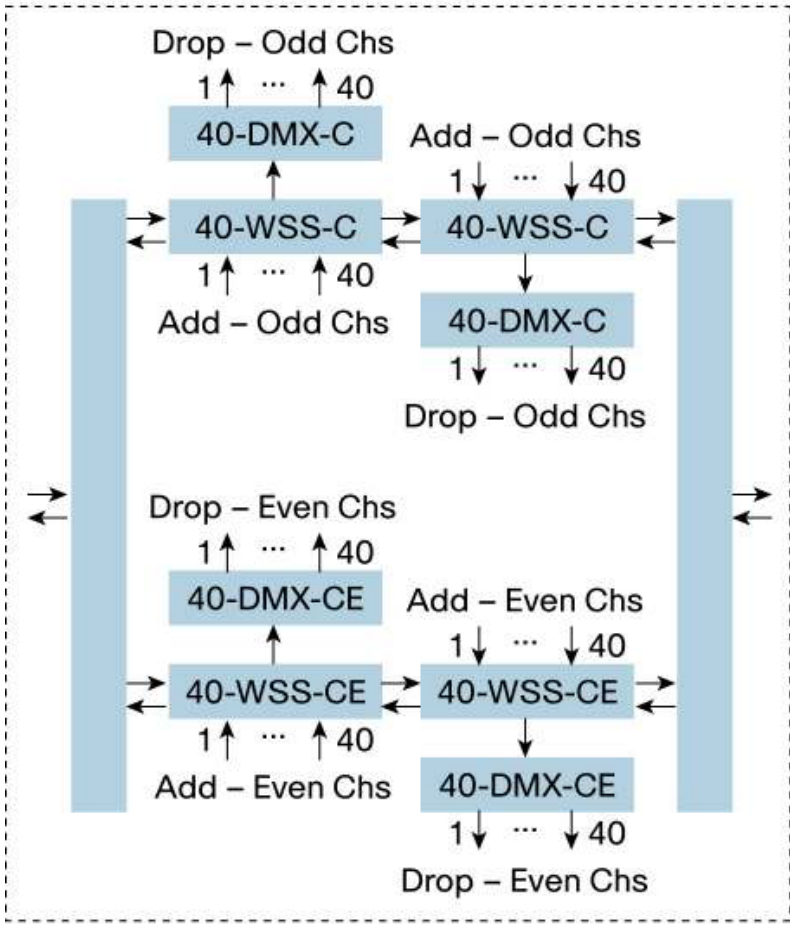
	end, point-and-click wavelength provisioning and easy SONET/SDH-like wavelength management."
46. The optical system of claim 45 wherein said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors.	The servo-control assembly of the Cisco ROADMs described in claim 2 further includes a spectral monitor for monitoring power levels of said spectral channels coupled into said output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors. As set forth in Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide "per-channel optical power monitoring using photodiodes" and "aggregate DWDM signal monitoring and control through a variable optical attenuator." In Cisco's ONS 15454 Data Sheet, Cisco describes the servo-control mechanism in its ROADM by explaining the dynamic control capabilities of its product as follows: "Embedded automatic power control mechanisms allow interfacing with different types of DWDM units without requiring external attenuators. Used in conjunction with Cisco ONS multiplexers and demultiplexers, these mechanisms allow the management of local add/drop traffic in the specific direction supported by the 80-WXC-C unit. "The Cisco ONS 15454 80-WXC-C card operates on the ITU 50-GHz wavelength plan. The card integrates automatic per-channel power monitor and control capabilities, providing node- and network-based automatic-power-level management on each input and output port. Per-channel optical path selection is also done in a completely automated way through Wavelength Path Provisioning (WPP) at the network level, featuring end-to-end, point-and-click wavelength provisioning and easy SONET/SDH-like wavelength management."
53. The optical system of claim 44 wherein said wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms.	Cisco's ROADMs include switching modules that include diffraction gratings. The diffraction grating that Cisco uses in its ROADMs can be a ruled diffraction grating, an halographic diffraction grating, an echelle grating, a curved diffraction grating, or a dispersing grating.

61. A method of performing dynamic wavelength separating and routing, comprising:	Cisco makes, uses, sells, imports, and/or offers to sell reconfigurable optical add drop multiplexers ("ROADMs") and other products that incorporate wavelength selective switches ("WSSs"), each of which is a wavelength separating-routing apparatus. Several documents detail the functionality of Cisco's ROADM products, including: • "Data Sheet: 40-Channel Reconfigurable Optical Add/Drop Multiplexing Portfolio for the Cisco ONS 15454 Multiservice Transport Platform," dated 1992-2007 ("ONS 15454 Data Sheet"); • "Data Sheet: Cisco NCS 2000 Service Line Cards," dated 2013 ("NCS 2000 Data Sheet 1"); • "Data Sheet: Cisco Network Convergence System 2000 ROADM and Amplifier Line Cards," dated 2013 ("NCS 2000 Data Sheet 2"); • "Cisco ONS 15200 Series DWDM Systems," from Cisco's website (www.cisco.com/c/en/us/products/optical-networking/ons-15200-series-dwdm-systems/index.html) ("ONS 15200 Webpage"); • "Data Sheet: Cisco ONS 15216 C L-Band Splitter/Combiner Module for Cisco ONS 15454 MSTP" dated 1992-2005 ("ONS 15200 Data Sheet"); • "Cisco NCS 2002 and NCS 2006 Line Card Configuration Guide, Release 10.x.x," chapter titled "Provisioning Reconfigurable Optical Add/Drop Cards," which "describes the line cards deployed in reconfigurable optical add/drop (ROADM) networks," pp12-16, which focus on the "40-WSS-C and 40-WSS-CE Card," and pp 31-38, which focus on "Single Module ROADM (SMR-C) Cards" ("ROADM Configuration Chapter"); and • information and documents available from Cisco's website (www.cisco.com) ("Website"). According to Cisco's ONS 15454 Data Sheet: "The Cisco® ONS 15454 Multiservice Transport Platform (MSTP) (Figure 1) provides a comprehensive, intelligent dense wavelength-division multiplexing (DWDM) solution for expanding metropolitan (metro) and regional bandwidth." Figure 1 is labeled as "40-Channel Wavelength Cross-Connect (40-WXC), Wavelength Selective Switch (40-WSS), Multiplexer (40-MUX), and Demultiplexer (40-DMX) Units." "While Wavelength Selective Switch (WSS) units provide degree-2 type reconfigurability (drop wavelength in a node vs. let it pass through the node), an ROADM node based on 40-WXC units can support up to degree-8

	reconfigurability. This means that for each wavelength it is possible to decide if it has to be locally dropped or routed to any of the other 7 pass-through directions of the node. Such a capability not only enhances the flexibility of the DWDM transport network but also dramatically reduces the need for costly transponders to perform optical-to-electrical-to-optical conversion (typically 2 transponders/crossponders per add/drop channel or wavelength)." "As even in complex mesh network topologies it is likely that degree-2 reconfigurability would be enough for most of the node, the 40-channel ROADM portfolio includes also two different versions of the 40-WSS units, one operating on the odd channels of the C band spectrum (40-WSS-C) and the other one operating on the even channels of the C band spectrum (40-WSS-CE). The units can be used in conjunction with existing 32-channel ROADM solutions and with 40-WXC units to provide the greatest degree of flexibility for Cisco ONS 15454 MSTP deployments." "Embedded automatic power control mechanisms feature the possibility to interface with different types of DWDM units without requiring external attenuators. Used in conjunction with the 40-channel Multiplexer and 40-channel Demultiplexer allows to manage local add/drop traffic of the specific direction supported by the 40-WXC unit." "Embedded automatic power control mechanisms feature the possibility to interface with different type of DWDM units without requiring external attenuators." A chart in Cisco's ONS 15454 Data Sheet lists the components within the 40-Channel ROADM Units, including a "40-Channel Wavelength Selective Switch" The following figure 3 from Cisco's ONS 15454 Data Sheet is a chart of the "MSTP 40-Channel Degree-2 ROADM Node" and shows how wavelength selective switches (labeled "WSS") are integrated within a Cisco's ROADM:



The following figure 4 from Cisco's ONS 15454 Data Sheet is a chart of the "MSTP 80-Channel Degree-2 ROADM Node" and shows how wavelength selective switches (labeled "WSS") are integrated within a Cisco's ROADM and how Cisco's ROADM can add and drop signals:

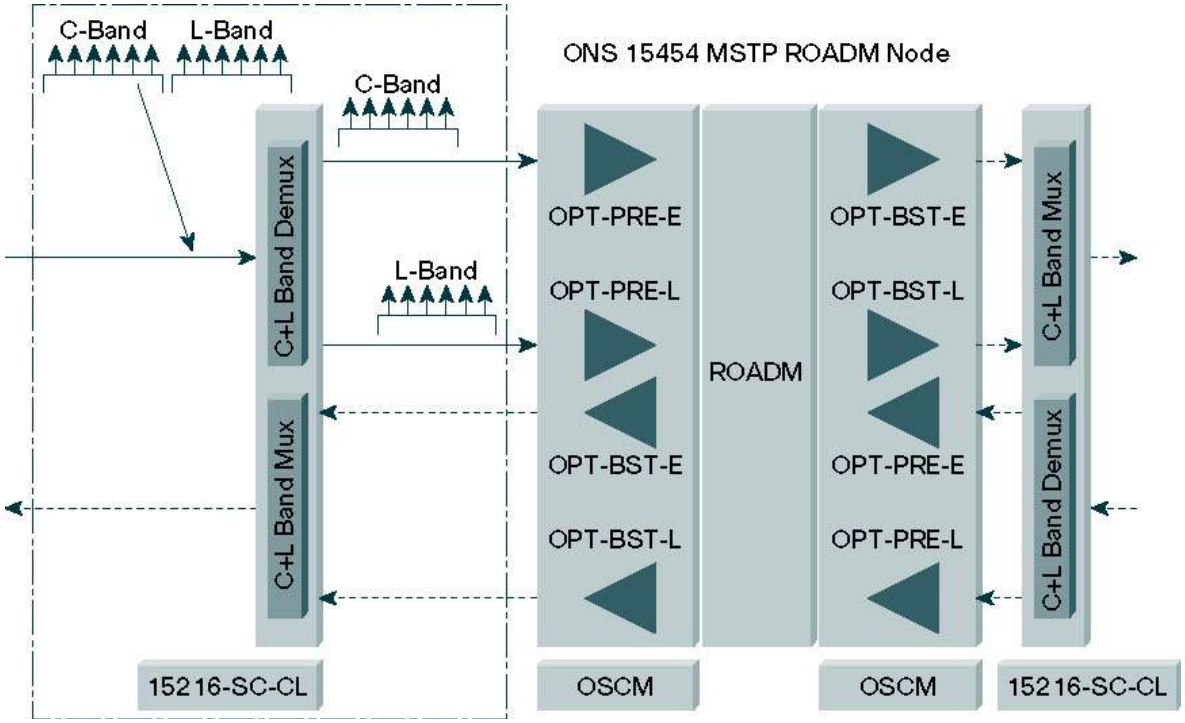


According to Cisco's ONS 15200 Data Sheet and ONS 15200 Webpage, both of which describe the ONS 15200 series of Cisco products, the ONS 15216 is the front end to the WSS ROADM in the ONS 15454. The ONS 15216 and ONS 15454 are integral to one another, so the ONS 15216 cannot work without the ONS 15454 and vice versa.

According to Cisco's ONS 15200 Webpage, "Cisco ONS 15200 Series DWDM Systems consist of intuitive,

compact, passive devices used in a variety of applications. These range from low latency, point-to-point data center interconnect to passive or reconfigurable optical add/drop multiplexer- (ROADM) based metropolitan rings."

According to Cisco's ONS 15200 Data Sheet, Figure 3 describes "Cisco ONS 15216 C+L-Band Splitter/Combiner Module Deployed in a Cisco ONS 15454 MSTP ROADM Node" and depicts the relationship of Cisco's 15200 series products with Cisco's 15454 ROADM as follows:

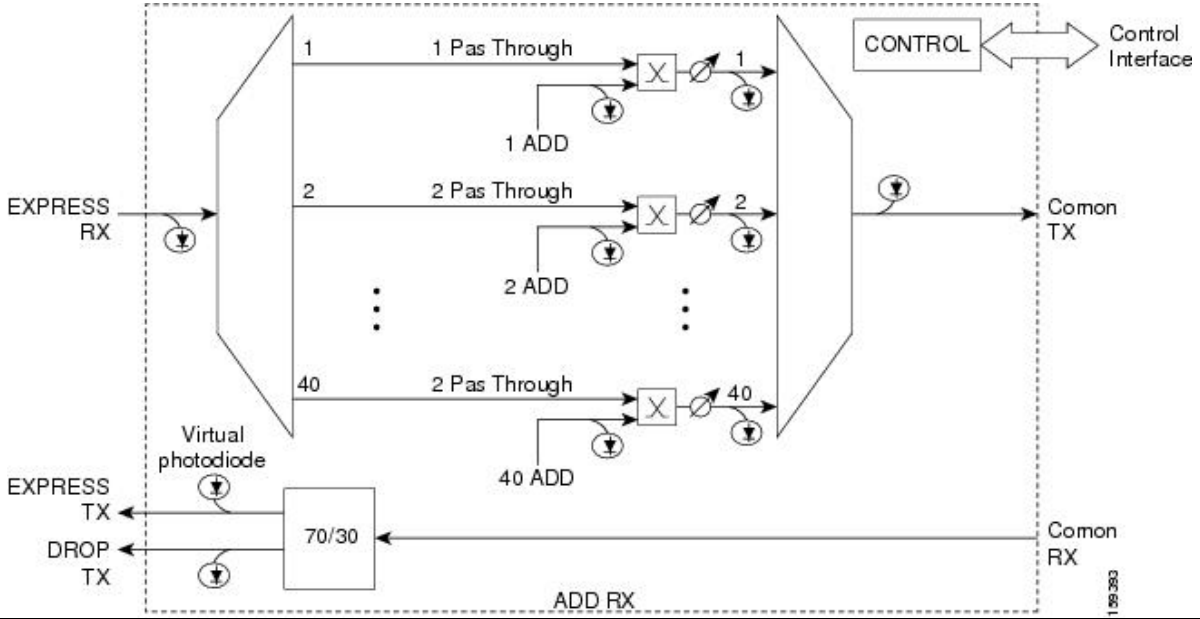


According to Cisco's ROADM Configuration Chapter, the Single Module ROADM (SMR-C) Cards are "single-slot 40-channel single module ROADM (SMR-C) cards" and they "integrate the following functional blocks onto a single line card:

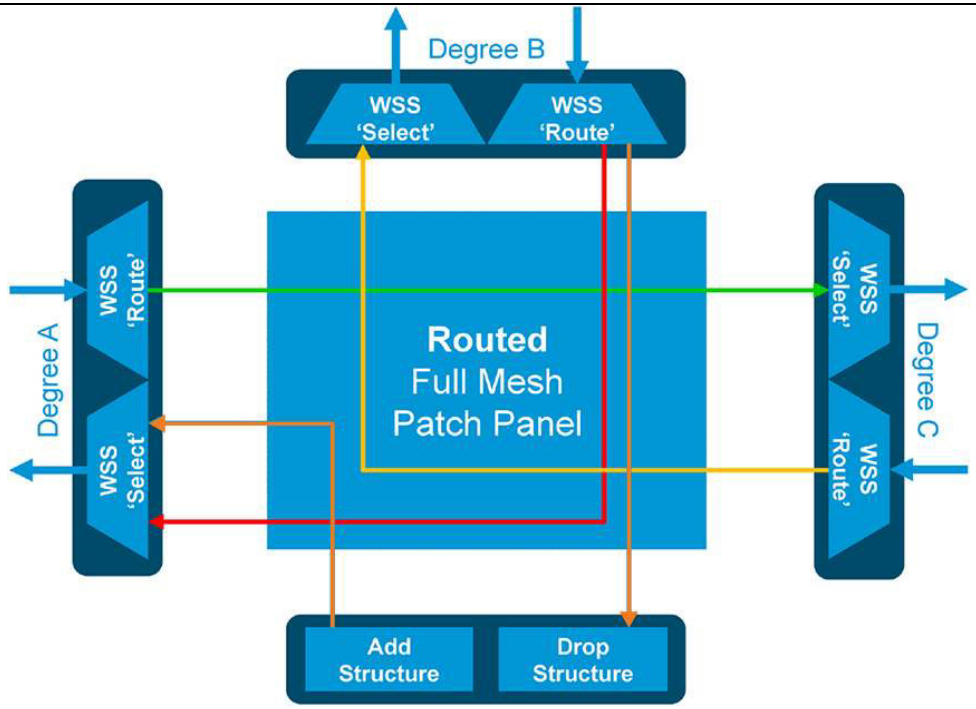
"• Optical preamplifier

• Optical booster amplifier

	• Optical service channel (OSC) filter • 2x1 wavelength cross-connect (WXC) or a 4x1 WXC • Optical channel monitor (OCM)" According to Cisco's ROADM Configuration Chapter, the Single Module ROADM (SMR-C) Cards "can manage up to 40 channels spaced at 100GHz on each port." Cisco's ROADM Configuration Chapter about provisioning reconfigurable optical add/drop cards describes the "40-WSS-C and 40-WSS-CE Card" as follows: "The double-slot 40-channel wavelength selective switch C-band (40-WSS-C) or the double-slot 40-channel wavelength selective switch even-channel C-band (40-WSS-CE) card switches 40 ITU-T 100-GHz-spaced channels identified in the channel plan (Table 4: Channel Allocation Plan or Table 5: Channel Allocation Plan) and sends them to dedicated output ports. The 40-WSS-C or 40-WSS-CE card is bidirectional and optically passive. The card can be installed in Slots 1 to 6 and 12 to 17 "The 40-WSS-C or 40-WSS-CE features include: • Receipt of an aggregate DWDM signal into 40 output optical channels from the Line receive port (EXP RX) in one direction and from the COM-RX port in the other direction. • Per-channel optical power monitoring using photodiodes. • Signal splitting in a 70%-to-30% ratio, sent to the 40-DMX-C (or 40-DMX-CE) for dropping signals, then to the other 40-WSS-C (or 40-WSS-CE) card. • Aggregate DWDM signal monitoring and control through a variable optical attenuator (VOA). In the case of electrical power failure, the VOA is set to its maximum attenuation for safety purposes. A manual VOA setting is also available." "Within the 40-WSS-C or 40-WSS-CE card, the first AWG opens the spectrum and each wavelength is directed to one of the ports of a 1x2 optical switch. The same wavelength can be passed through or stopped. If the pass-through wavelength is stopped, a new channel can be added at the ADD port. The card's second AWG multiplexes all of the wavelengths, and the aggregate signal is output through the COM-TX port." "The 40-WSS-C or 40-WSS-CE has eight types of ports: • ADD RX ports (1 to 40): These ports are used for adding channels. Each add channel is associated with an

	individual switch element that selects whether an individual channel is added. Each add port has optical power regulation provided by a VOA. The five connectors on the card faceplate accept MPO cables for the client input interfaces. MPO cables break out into eight separate cables. The 40-WSS-C or 40-WSS-CE card also has one LC-PC-II optical connector for the main input. • COM RX: The COM RX port receives the optical signal from a preamplifier (such as the OPT-PRE) and sends it to the optical splitter. • COM TX: The COM TX port sends an aggregate optical signal to a booster amplifier card (for example, the OPT-BST card) for transmission outside of the NE. • EXP RX port: The EXP RX port receives an optical signal from another 40-WSS-C or 40-WSS-CE card in the same NE. • EXP TX: The EXP TX port sends an optical signal to the other 40-WSS-C or 40-WSS-CE card within the NE. • DROP TX port: The DROP TX port sends the split off optical signal that contains drop channels to the 40-DMX-C(or 40-DMX-CE) card, where the channels are further processed and dropped. "The following figure shows a functional block diagram of the 40-WSS-C or 40-WSS-CE card: Figure 3: 40-WSS-C or 40-WSS-CE Block Diagram:" 

	According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide ROADM functionality as follows: "The 40-WSS-C (or 40-WSS-CE) card works in combination with the 40-DMX-C (or 40-DMX-CE) card to implement ROADM functionality. As a ROADM node, the node can be configured at the optical channel level using CTC, Cisco Transport Planner, and CTM. ROADM functionality using the 40-WSS-C (or 40-WSS-CE) card requires two 40-WSS-C (or 40-WSS-CE) double-slot cards and two 40-DMX-C (or 40-DMX-CE) single-slot cards (for a total of six slots in the chassis)." According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide power monitoring functionality as follows: "The 40-WSS-C (or 40-WSS-CE) has physical diodes that monitor power at various locations on the card. The following table lists the physical diode descriptions." According to Cisco's NCS 2000 Data Sheet 2, Cisco provides a ROADM as follows: "The Cisco 16-port Flex Spectrum ROADM Line Card (16-WXC-FS) is a double-slot unit that provides multidegree switching capabilities not only at the individual wavelength level but also with flexible spectrum allocations. You can use the 16-port Flex Spectrum ROADM Line Card in the core of the network to build ROADM nodes with 96 channels spaced at 50-GHz, FlexSpectrum channels, or a combination of the two. By using a simple software reconfiguration, the same unit can provide colorless multiplexing and demultiplexing to ROADM nodes." Figure 4 of Cisco's NCS 2000 Data Sheet 2 provides a picture of the "16-port Flex Spectrum ROADM Line Card N-Degree ROADM Layout," which includes several WSS devices:

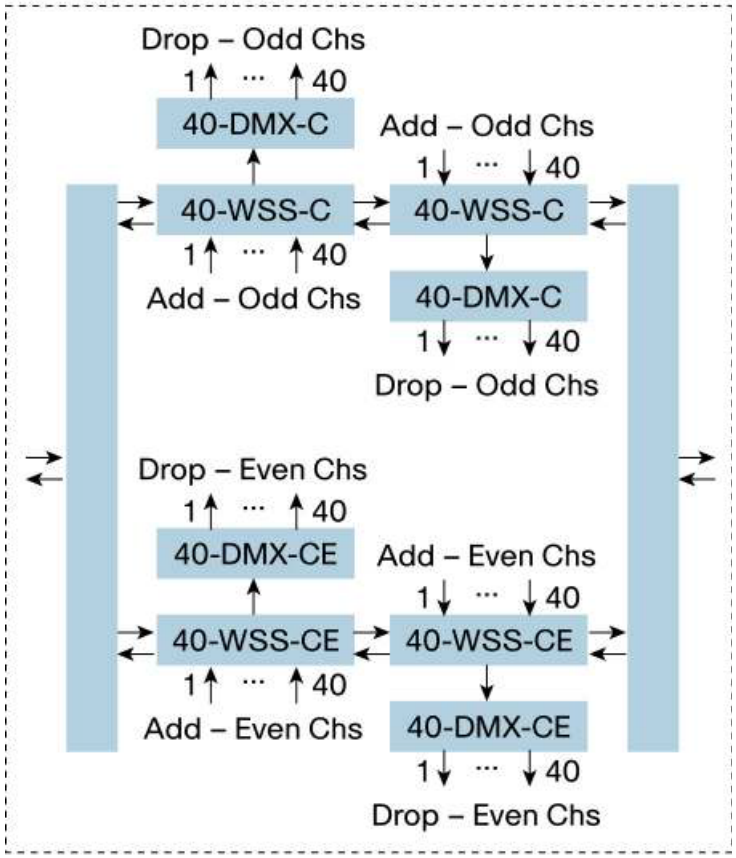
	 Cisco's ONS 15454 Data Sheet also states that it's 40-WXC-C component in its ROADM devices use "MEMS," which are micro-electromechanical mirrors, to switch (route/add/drop/attenuate/etc.) the signals.
a) receiving a multi-wavelength optical signal from an input port;	Using its ROADMs, Cisco and others, acting at the direction and/or control of Cisco, receive a multi-wavelength optical signal from an input port. According to Cisco's Website, its various Data Sheets, and its other materials describing its ROADM Products' functionality, Cisco's ROADMs include a switching module that receives an optical signal that is comprised of multiple wavelengths.
b) separating said multi-wavelength optical signal into multiple spectral channels;	Using its ROADMs, Cisco and others, acting at the direction and/or control of Cisco, separate said multi-wavelength optical signal into multiple spectral channels.

	The Cisco ROADMs include a wavelength separator, for separating multi-wavelength optical signal from said input port into multiple spectral channels. According to Cisco's Data Sheets and website, Cisco's ROADM products include a WSS-based card ("switching module"). The switching module includes a wavelength separator, for separating multi-wavelength optical signal from said input port into multiple spectral channels.
c) focusing said spectral channels onto a spatial array of corresponding beam-deflecting elements, whereby each beam-deflecting element receives one of said spectral channels; and	Using its ROADMs, Cisco and others, acting at the direction and/or control of Cisco, focus said spectral channels onto a spatial array of corresponding beam-deflecting elements, whereby each beam-deflecting element receives one of said spectral channels. The Cisco ROADMs include a beam-focuser, for focusing said spectral channels into corresponding spectral spots. According to Cisco's Data Sheets and website, Cisco's ROADM products include a WSS-based card ("switching module"). The switching module includes a beam-focuser, for focusing said spectral channels into corresponding spectral spots. The Cisco ROADMs include a spatial array of beam-deflecting elements, whereby each beam-deflecting element receives one of said spectral channels. According to Cisco's Data Sheets and website, Cisco's ROADM products include a WSS-based card ("switching module"). The switching module includes a spatial array of beam-deflecting elements, whereby each beam-deflecting element receives one of said spectral channels. According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide complete ROADM functionality and allow for the adding, dropping, multiplexing, switching, and routing of signals on an individual wavelength level. According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide ROADM functionality as follows: "The 40-WSS-C (or 40-WSS-CE) card works in combination with the 40-DMX-C (or 40-DMX-CE) card to

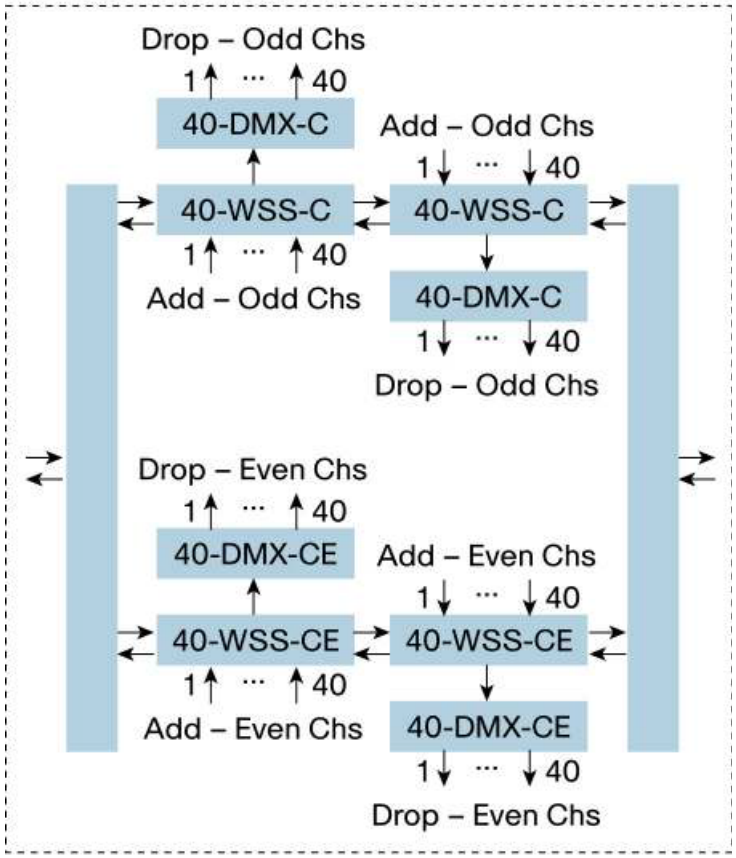
	implement ROADM functionality. As a ROADM node, the node can be configured at the optical channel level using CTC, Cisco Transport Planner, and CTM. ROADM functionality using the 40-WSS-C (or 40-WSS-CE) card requires two 40-WSS-C (or 40-WSS-CE) double-slot cards and two 40-DMX-C (or 40-DMX-CE) single-slot cards (for a total of six slots in the chassis)." According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide power monitoring functionality as follows: "The 40-WSS-C (or 40-WSS-CE) has physical diodes that monitor power at various locations on the card. The following table lists the physical diode descriptions." Cisco's ONS 15454 Data Sheet also states that it's 40-WXC-C component in its ROADM devices use "MEMS," which are micro-electromechanical mirrors, to switch (route/add/drop/attenuate/etc.) the signals.
d) dynamically and continuously controlling said beam-deflecting elements in two dimensions to direct said spectral channels into any selected ones of said output ports and to control the power of the spectral channels coupled into said selected output ports.	Using its ROADMs, Cisco and others, acting at the direction and/or control of Cisco, dynamically and continuously control said beam-deflecting elements, thereby directing in two dimensions to direct said spectral channels into a plurality any selected ones of said output ports and to control the power of the spectral channels coupled into said selected output ports. According to Cisco's Website, its various Data Sheets, and its other materials describing its ROADM Products' functionality, Cisco's ROADMs include a switching module that is WSS-based. The switching module includes beam-deflecting elements, which can be dynamically and continuously controlled in two dimensions to direct said spectral channels into any selected ones of said output ports and to control the power of the spectral channels coupled into said output ports. According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide complete ROADM functionality and allow for the adding, dropping, multiplexing, switching, and routing of signals on an individual wavelength level. According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide ROADM functionality as follows: "The 40-WSS-C (or 40-WSS-CE) card works in combination with the 40-DMX-C (or 40-DMX-CE) card to

	implement ROADM functionality. As a ROADM node, the node can be configured at the optical channel level using CTC, Cisco Transport Planner, and CTM. ROADM functionality using the 40-WSS-C (or 40-WSS-CE) card requires two 40-WSS-C (or 40-WSS-CE) double-slot cards and two 40-DMX-C (or 40-DMX-CE) single-slot cards (for a total of six slots in the chassis)." According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide power monitoring functionality as follows: "The 40-WSS-C (or 40-WSS-CE) has physical diodes that monitor power at various locations on the card. The following table lists the physical diode descriptions." Cisco's ONS 15454 Data Sheet also states that it's 40-WXC-C component in its ROADM devices use "MEMS," which are micro-electromechanical mirrors, to switch (route/add/drop/attenuate/etc.) the signals.
62. The method of claim 61 further comprising the step of providing feedback control of said beam-deflecting elements to maintain a predetermining coupling of each spectral channel directed into one of said output ports.	Using its ROADMs, Cisco and others, acting at the direction and/or control of Cisco, provide feedback control of said beam-deflecting elements to maintain a predetermining coupling of each spectral channel directed into one of said output ports. Cisco's ROADMs, used as described in claim 61, further include a servo-control assembly that provides feedback control of the beam-deflecting elements to maintain a predetermined coupling of each reflected spectral channel into one of said output ports. As set forth in Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide "per-channel optical power monitoring using photodiodes" and "aggregate DWDM signal monitoring and control through a variable optical attenuator." In Cisco's ONS 15454 Data Sheet, Cisco describes the servo-control mechanism in its ROADM by explaining the dynamic control capabilities of its product as follows: "Embedded automatic power control mechanisms allow interfacing with different types of DWDM units without requiring external attenuators. Used in conjunction with Cisco ONS multiplexers and demultiplexers, these mechanisms allow the management of local add/drop traffic in the specific direction supported by the 80-WXC-C unit.

	"The Cisco ONS 15454 80-WXC-C card operates on the ITU 50-GHz wavelength plan. The card integrates automatic per-channel power monitor and control capabilities, providing node- and network-based automatic-power-level management on each input and output port. Per-channel optical path selection is also done in a completely automated way through Wavelength Path Provisioning (WPP) at the network level, featuring end-to-end, point-and-click wavelength provisioning and easy SONET/SDH-like wavelength management."
63. The method of claim 62 further comprising the step of maintaining power levels of said spectral channels directed into said output ports at a predetermining value.	Using its ROADMs as described in claim 62, Cisco and others, acting at the direction and/or control of Cisco, further maintain power levels of said spectral channels directed into said output ports at a predetermining value. As set forth in Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide "per-channel optical power monitoring using photodiodes" and "aggregate DWDM signal monitoring and control through a variable optical attenuator." In Cisco's ONS 15454 Data Sheet, Cisco describes the servo-control mechanism in its ROADM by explaining the dynamic control capabilities of its product as follows: "Embedded automatic power control mechanisms allow interfacing with different types of DWDM units without requiring external attenuators. Used in conjunction with Cisco ONS multiplexers and demultiplexers, these mechanisms allow the management of local add/drop traffic in the specific direction supported by the 80-WXC-C unit. "The Cisco ONS 15454 80-WXC-C card operates on the ITU 50-GHz wavelength plan. The card integrates automatic per-channel power monitor and control capabilities, providing node- and network-based automatic-power-level management on each input and output port. Per-channel optical path selection is also done in a completely automated way through Wavelength Path Provisioning (WPP) at the network level, featuring end-to-end, point-and-click wavelength provisioning and easy SONET/SDH-like wavelength management."
64. The method of claim 61 wherein each spectral channel is directed into a separate output port.	Using its ROADMs as described in claim 61, Cisco and others, acting at the direction and/or control of Cisco, direct each spectral channel into a separate output port. The following figure 4 from Cisco's ONS 15454 Data Sheet is a chart of the "MSTP 80-Channel Degree-2 ROADM Node" and shows that there are numerous output ports in Cisco's ROADMs. Each spectral channel

	can be directed to a separate output port: 
65. The method of claim 61 wherein a subset of said spectral channels is directed into one of said output ports, thereby providing one or more pass-through spectral channels.	Using its ROADMs as described in claim 61, Cisco and others, acting at the direction and/or control of Cisco, direct a subset of said spectral channels into one of said output ports, thereby providing one or more pass-through spectral channels. The following figure 4 from Cisco's ONS 15454 Data Sheet is a chart of the "MSTP 80-Channel Degree-2 ROADM Node" and shows that there are numerous output ports in Cisco's ROADMs. A subset of said spectral channels can be directed into one of the output ports, thereby providing one or more pass-through spectral

channels:


Drop – Odd Chs
1 ··· 40
40-DMX-C
Add – Odd Chs
1 ··· 40
40-WSS-C
40-WSS-C
1 ··· 40
Add – Odd Chs
40-DMX-C
1 ··· 40
Drop – Odd Chs
Drop – Even Chs
1 ··· 40
40-DMX-CE
Add – Even Chs
1 ··· 40
40-WSS-CE
40-WSS-CE
1 ··· 40
Add – Even Chs
40-DMX-CE
1 ··· 40
Drop – Even Chs

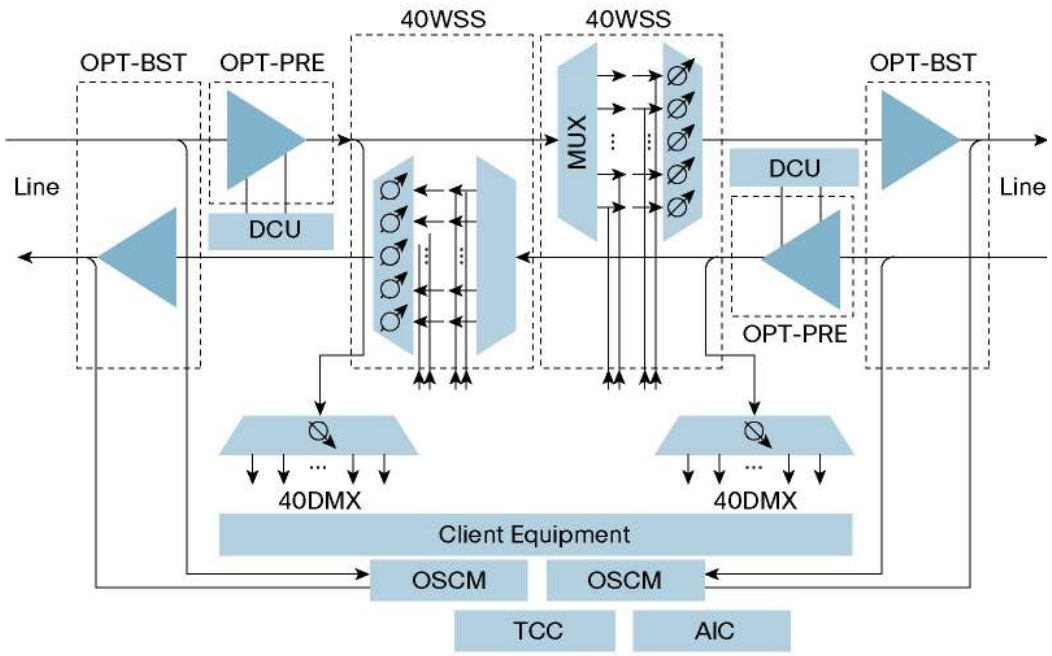
APPENDIX B

Claims 1-6, 9-12, 15-22 of U.S. Patent No. RE42,368
v.
Cisco Reconfigurable Optical Add Drop Multiplexers ("ROADM") Accused Devices

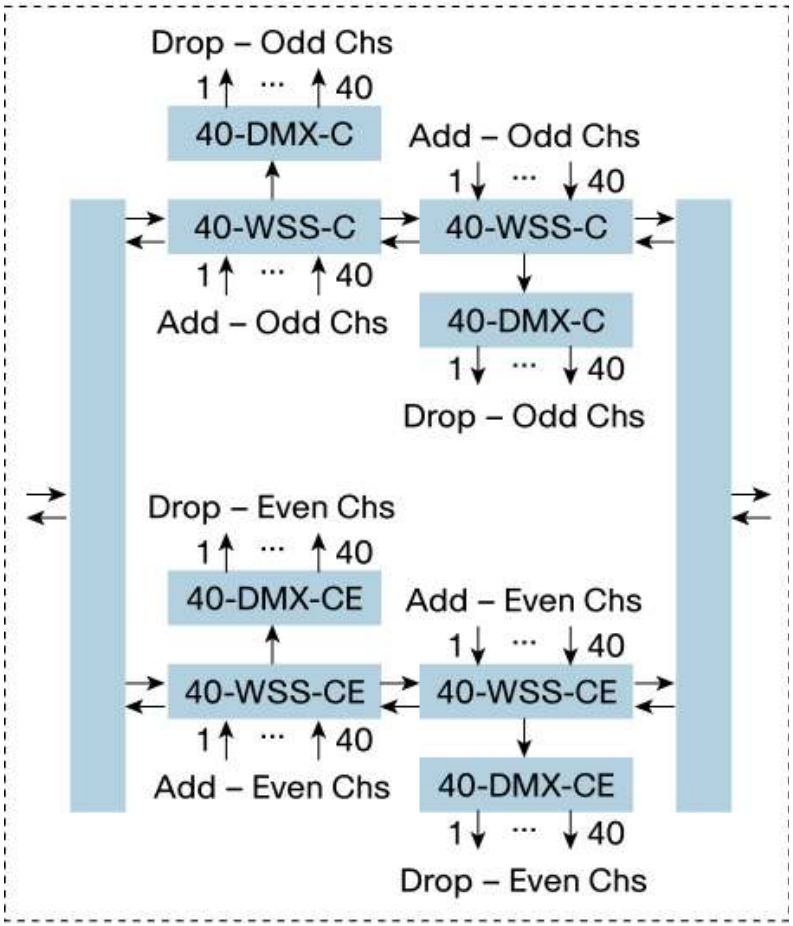
Claim	Product Analysis
1. An optical add-drop apparatus comprising:	Cisco makes, uses, sells, imports, and/or offers to sell reconfigurable optical add drop multiplexers ("ROADMs") and other products that incorporate wavelength selective switches ("WSSs"), each of which is a wavelength separating-routing apparatus. Cisco makes, uses, sells, imports, and/or offers to sell reconfigurable optical add drop multiplexers ("ROADMs") and other products that incorporate wavelength selective switches ("WSSs"), each of which is a wavelength separating-routing apparatus. Several documents detail the functionality of Cisco's ROADM products, including: • "Data Sheet: 40-Channel Reconfigurable Optical Add/Drop Multiplexing Portfolio for the Cisco ONS 15454 Multiservice Transport Platform," dated 1992-2007 ("ONS 15454 Data Sheet"); • "Data Sheet: Cisco NCS 2000 Service Line Cards," dated 2013 ("NCS 2000 Data Sheet 1"); • "Data Sheet: Cisco Network Convergence System 2000 ROADM and Amplifier Line Cards," dated 2013 ("NCS 2000 Data Sheet 2"); • "Cisco ONS 15200 Series DWDM Systems," from Cisco's website (www.cisco.com/c/en/us/products/optical-networking/ons-15200-series-dwdm-systems/index.html) ("ONS 15200 Webpage"); • "Data Sheet: Cisco ONS 15216 C L-Band Splitter/Combiner Module for Cisco ONS 15454 MSTP" dated 1992-2005 ("ONS 15200 Data Sheet"); • "Cisco NCS 2002 and NCS 2006 Line Card Configuration Guide, Release 10.x.x," chapter titled "Provisioning Reconfigurable Optical Add/Drop Cards," which "describes the line cards deployed in reconfigurable optical add/drop (ROADM) networks," pp12-16, which focus on the "40-WSS-C and 40-WSS-CE Card," and pp 31-38, which focus on "Single Module ROADM (SMR-C) Cards" ("ROADM Configuration Chapter"); and • information and documents available from Cisco's website (www.cisco.com) ("Website").

	According to Cisco's ONS 15454 Data Sheet: "The Cisco® ONS 15454 Multiservice Transport Platform (MSTP) (Figure 1) provides a comprehensive, intelligent dense wavelength-division multiplexing (DWDM) solution for expanding metropolitan (metro) and regional bandwidth." Figure 1 is labeled as "40-Channel Wavelength Cross-Connect (40-WXC), Wavelength Selective Switch (40-WSS), Multiplexer (40-MUX), and Demultiplexer (40-DMX) Units." "While Wavelength Selective Switch (WSS) units provide degree-2 type reconfigurability (drop wavelength in a node vs. let it pass through the node), an ROADM node based on 40-WXC units can support up to degree-8 reconfigurability. This means that for each wavelength it is possible to decide if it has to be locally dropped or routed to any of the other 7 pass-through directions of the node. Such a capability not only enhances the flexibility of the DWDM transport network but also dramatically reduces the need for costly transponders to perform optical-to-electrical-to-optical conversion (typically 2 transponders/crossponders per add/drop channel or wavelength)." "As even in complex mesh network topologies it is likely that degree-2 reconfigurability would be enough for most of the node, the 40-channel ROADM portfolio includes also two different versions of the 40-WSS units, one operating on the odd channels of the C band spectrum (40-WSS-C) and the other one operating on the even channels of the C band spectrum (40-WSS-CE). The units can be used in conjunction with existing 32-channel ROADM solutions and with 40-WXC units to provide the greatest degree of flexibility for Cisco ONS 15454 MSTP deployments." "Embedded automatic power control mechanisms feature the possibility to interface with different types of DWDM units without requiring external attenuators. Used in conjunction with the 40-channel Multiplexer and 40-channel Demultiplexer allows to manage local add/drop traffic of the specific direction supported by the 40-WXC unit." "Embedded automatic power control mechanisms feature the possibility to interface with different type of DWDM units without requiring external attenuators." A chart in Cisco's ONS 15454 Data Sheet lists the components within the 40-Channel ROADM Units, including a "40-Channel Wavelength Selective Switch"

The following figure 3 from Cisco's ONS 15454 Data Sheet is a chart of the "MSTP 40-Channel Degree-2 ROADM Node" and shows how wavelength selective switches (labeled "WSS") are integrated within a Cisco's ROADM:



The following figure 4 from Cisco's ONS 15454 Data Sheet is a chart of the "MSTP 80-Channel Degree-2 ROADM Node" and shows how wavelength selective switches (labeled "WSS") are integrated within a Cisco's ROADM and how Cisco's ROADM can add and drop signals:

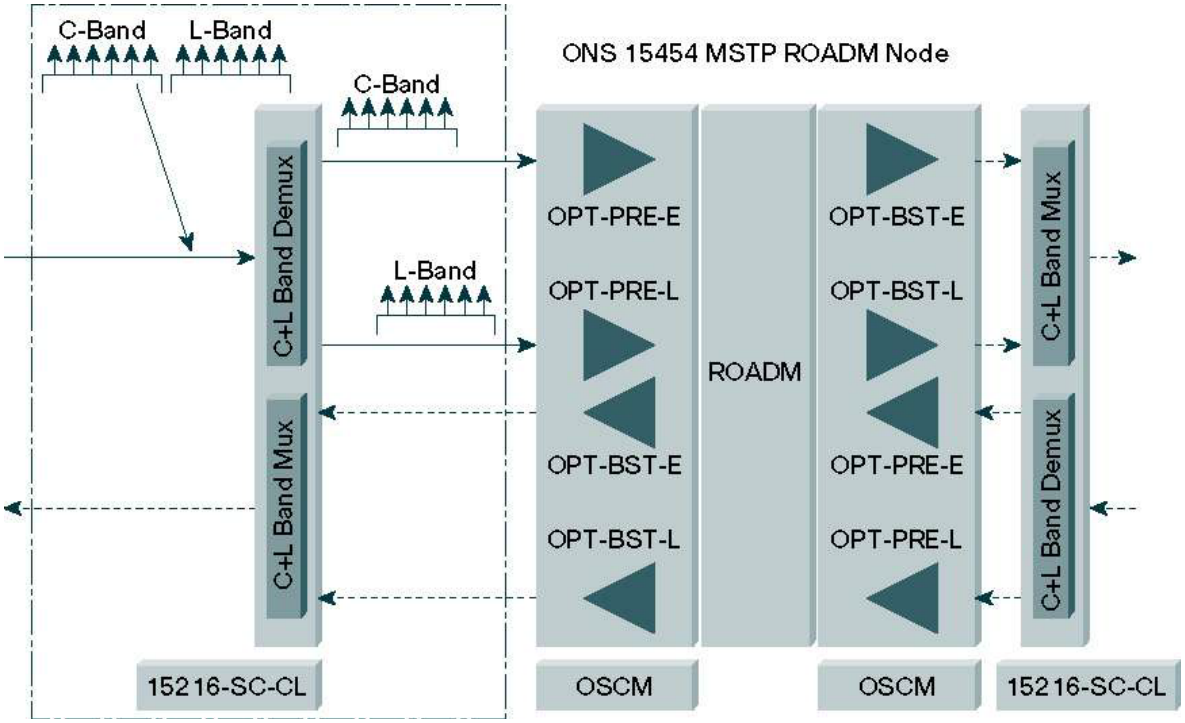


According to Cisco's ONS 15200 Data Sheet and ONS 15200 Webpage, both of which describe the ONS 15200 series of Cisco products, the ONS 15216 is the front end to the WSS ROADM in the ONS 15454. The ONS 15216 and ONS 15454 are integral to one another, so the ONS 15216 cannot work without the ONS 15454 and vice versa.

According to Cisco's ONS 15200 Webpage, "Cisco ONS 15200 Series DWDM Systems consist of

intuitive, compact, passive devices used in a variety of applications. These range from low latency, point-to-point data center interconnect to passive or reconfigurable optical add/drop multiplexer- (ROADM) based metropolitan rings."

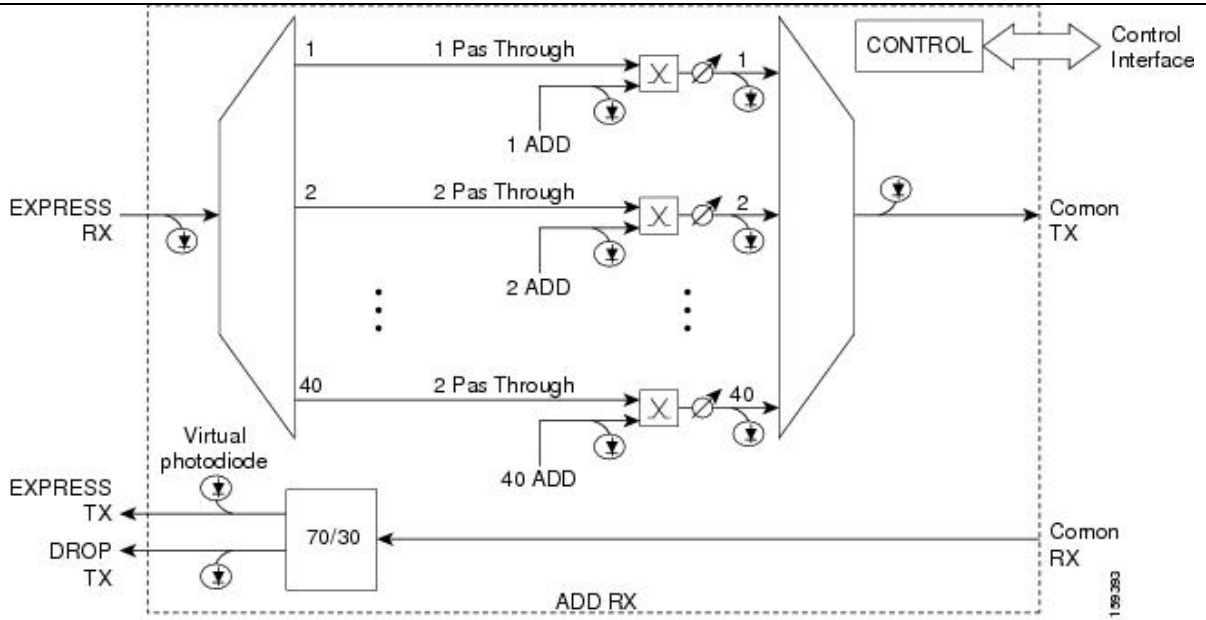
According to Cisco's ONS 15200 Data Sheet, Figure 3 describes "Cisco ONS 15216 C+L-Band Splitter/Combiner Module Deployed in a Cisco ONS 15454 MSTP ROADM Node" and depicts the relationship of Cisco's 15200 series products with Cisco's 15454 ROADM as follows:



According to Cisco's ROADM Configuration Chapter, the Single Module ROADM (SMR-C) Cards are "single-slot 40-channel single module ROADM (SMR-C) cards" and they "integrate the following functional blocks onto a single line card:
"• Optical preamplifier
• Optical booster amplifier

	• Optical service channel (OSC) filter • 2x1 wavelength cross-connect (WXC) or a 4x1 WXC • Optical channel monitor (OCM)" According to Cisco's ROADM Configuration Chapter, the Single Module ROADM (SMR-C) Cards "can manage up to 40 channels spaced at 100GHz on each port." Cisco's ROADM Configuration Chapter about provisioning reconfigurable optical add/drop cards describes the "40-WSS-C and 40-WSS-CE Card" as follows: "The double-slot 40-channel wavelength selective switch C-band (40-WSS-C) or the double-slot 40-channel wavelength selective switch even-channel C-band (40-WSS-CE) card switches 40 ITU-T 100-GHz-spaced channels identified in the channel plan (Table 4: Channel Allocation Plan or Table 5: Channel Allocation Plan) and sends them to dedicated output ports. The 40-WSS-C or 40-WSS-CE card is bidirectional and optically passive. The card can be installed in Slots 1 to 6 and 12 to 17 "The 40-WSS-C or 40-WSS-CE features include: • Receipt of an aggregate DWDM signal into 40 output optical channels from the Line receive port (EXP RX) in one direction and from the COM-RX port in the other direction. • Per-channel optical power monitoring using photodiodes. • Signal splitting in a 70%-to-30% ratio, sent to the 40-DMX-C (or 40-DMX-CE) for dropping signals, then to the other 40-WSS-C (or 40-WSS-CE) card. • Aggregate DWDM signal monitoring and control through a variable optical attenuator (VOA). In the case of electrical power failure, the VOA is set to its maximum attenuation for safety purposes. A manual VOA setting is also available." "Within the 40-WSS-C or 40-WSS-CE card, the first AWG opens the spectrum and each wavelength is directed to one of the ports of a 1x2 optical switch. The same wavelength can be passed through or stopped. If the pass-through wavelength is stopped, a new channel can be added at the ADD port. The card's second AWG multiplexes all of the wavelengths, and the aggregate signal is output through the COM-TX port." "The 40-WSS-C or 40-WSS-CE has eight types of ports: • ADD RX ports (1 to 40): These ports are used for adding channels. Each add channel is associated with an

	individual switch element that selects whether an individual channel is added. Each add port has optical power regulation provided by a VOA. The five connectors on the card faceplate accept MPO cables for the client input interfaces. MPO cables break out into eight separate cables. The 40-WSS-C or 40-WSS-CE card also has one LC-PC-II optical connector for the main input. • COM RX: The COM RX port receives the optical signal from a preamplifier (such as the OPT-PRE) and sends it to the optical splitter. • COM TX: The COM TX port sends an aggregate optical signal to a booster amplifier card (for example, the OPT-BST card) for transmission outside of the NE. • EXP RX port: The EXP RX port receives an optical signal from another 40-WSS-C or 40-WSS-CE card in the same NE. • EXP TX: The EXP TX port sends an optical signal to the other 40-WSS-C or 40-WSS-CE card within the NE. • DROP TX port: The DROP TX port sends the split off optical signal that contains drop channels to the 40-DMX-C(or 40-DMX-CE) card, where the channels are further processed and dropped. “The following figure shows a functional block diagram of the 40-WSS-C or 40-WSS-CE card: Figure 3: 40-WSS-C or 40-WSS-CE Block Diagram:”



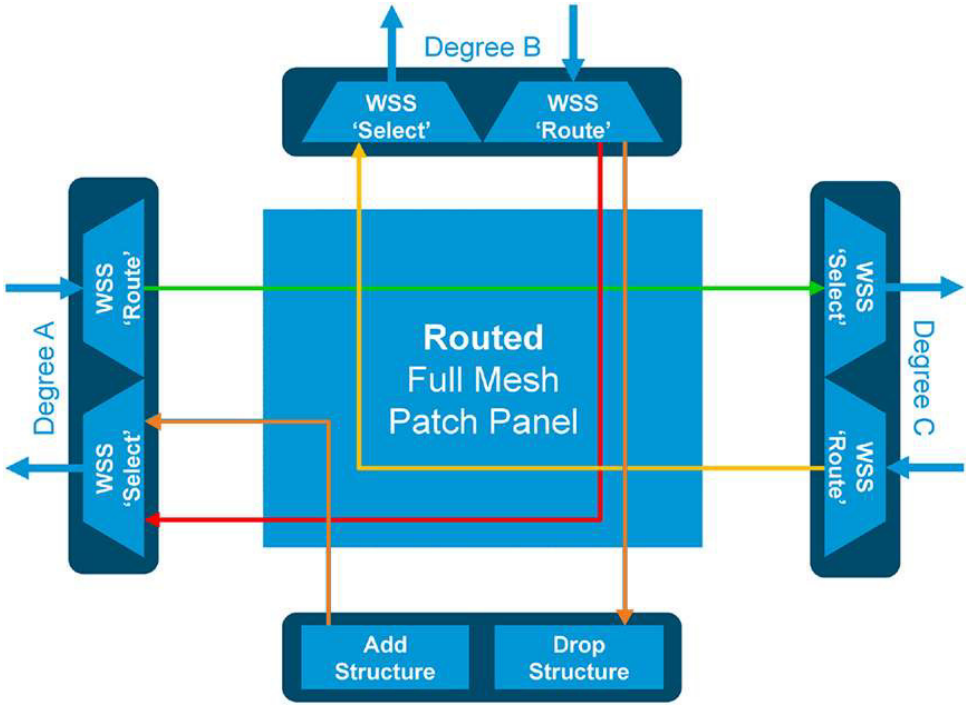
According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide ROADM functionality as follows:

"The 40-WSS-C (or 40-WSS-CE) card works in combination with the 40-DMX-C (or 40-DMX-CE) card to implement ROADM functionality. As a ROADM node, the node can be configured at the optical channel level using CTC, Cisco Transport Planner, and CTM. ROADM functionality using the 40-WSS-C (or 40-WSS-CE) card requires two 40-WSS-C (or 40-WSS-CE) double-slot cards and two 40-DMX-C (or 40-DMX-CE) single-slot cards (for a total of six slots in the chassis)."

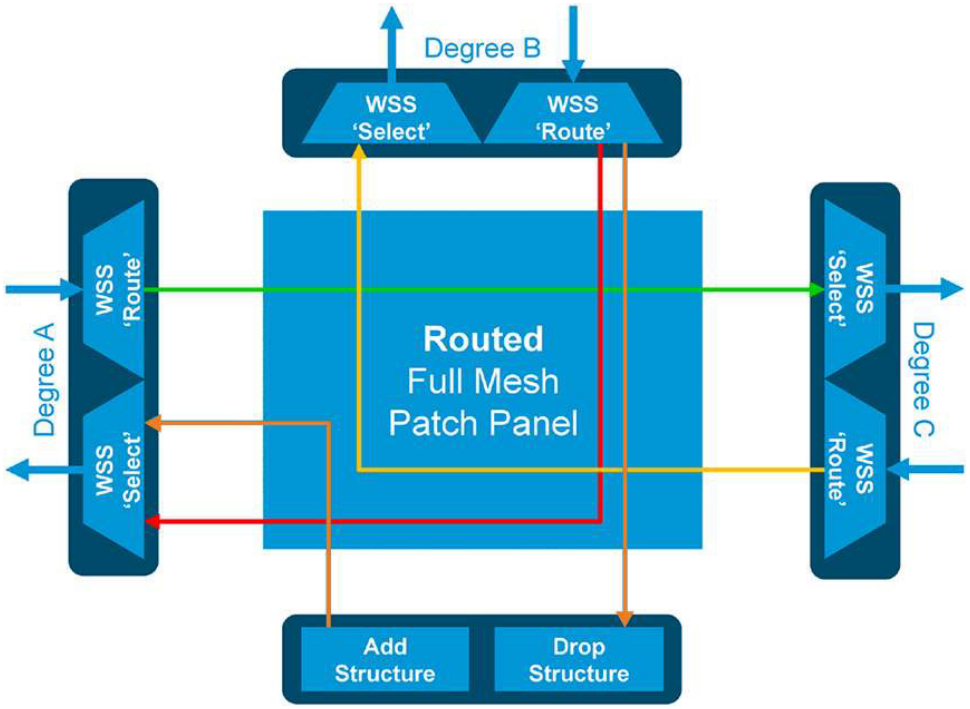
According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide power monitoring functionality as follows:

"The 40-WSS-C (or 40-WSS-CE) has physical diodes that monitor power at various locations on the card. The following table lists the physical diode descriptions."

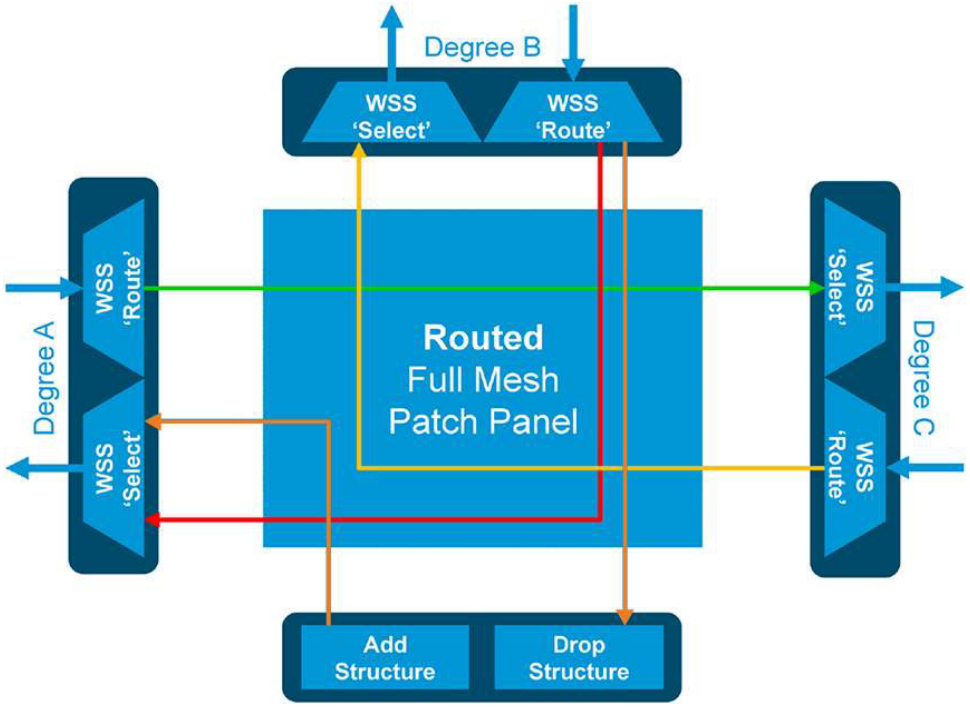
According to Cisco's NCS 2000 Data Sheet 2, Cisco provides a ROADM as follows:

	"The Cisco 16-port Flex Spectrum ROADM Line Card (16-WXC-FS) is a double-slot unit that provides multidegree switching capabilities not only at the individual wavelength level but also with flexible spectrum allocations. You can use the 16-port Flex Spectrum ROADM Line Card in the core of the network to build ROADM nodes with 96 channels spaced at 50-GHz, FlexSpectrum channels, or a combination of the two. By using a simple software reconfiguration, the same unit can provide colorless multiplexing and demultiplexing to ROADM nodes." Figure 4 of Cisco's NCS 2000 Data Sheet 2 provides a picture of the "16-port Flex Spectrum ROADM Line Card N-Degree ROADM Layout," which includes several WSS devices:  Cisco's ONS 15454 Data Sheet also states that it's 40-WXC-C component in its ROADM devices use "MEMS," which are micro-electromechanical mirrors, to switch (route/add/drop/attenuate/etc.) the signals.

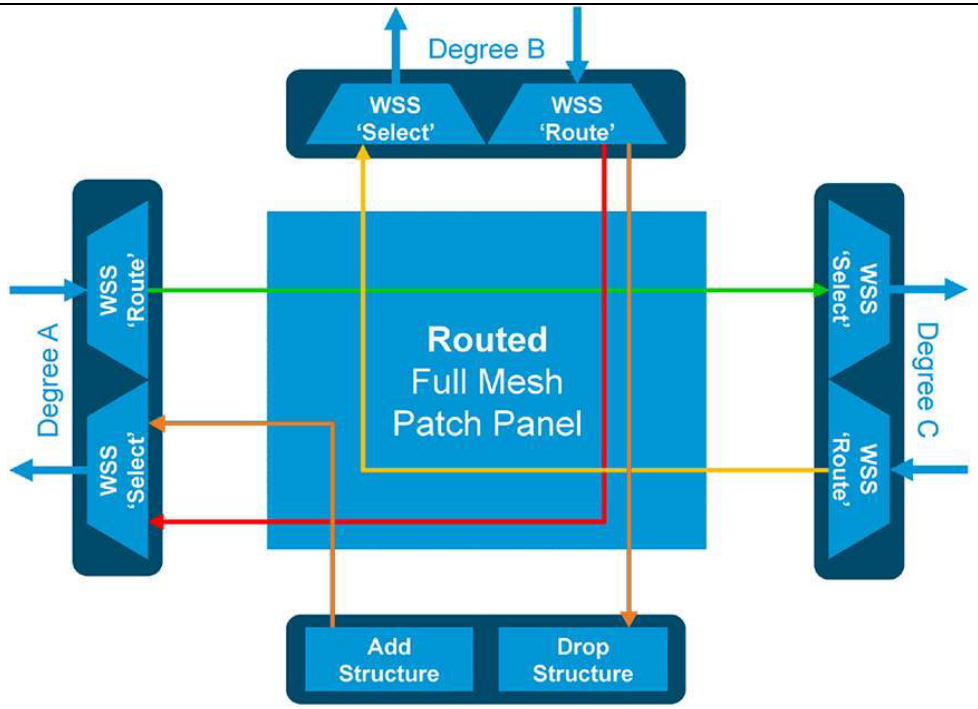
an input port for an input multi-wavelength optical signal having first spectral channels;	Cisco's ROADMs include an input port for an input multi-wavelength optical signal having first spectral channels. As shown in Cisco's ROADM Configuration Chapter about provisioning reconfigurable optical add/drop cards, Cisco's ROADM includes an input port for an input multi-wavelength optical signal having first spectral channels as follows: "The 40-WSS-C or 40-WSS-CE has eight types of ports: • ADD RX ports (1 to 40): These ports are used for adding channels. Each add channel is associated with an individual switch element that selects whether an individual channel is added. Each add port has optical power regulation provided by a VOA. The five connectors on the card faceplate accept MPO cables for the client input interfaces. MPO cables break out into eight separate cables. The 40-WSS-C or 40-WSS-CE card also has one LC-PC-II optical connector for the main input. • COM RX: The COM RX port receives the optical signal from a preamplifier (such as the OPT-PRE) and sends it to the optical splitter. • COM TX: The COM TX port sends an aggregate optical signal to a booster amplifier card (for example, the OPT-BST card) for transmission outside of the NE. • EXP RX port: The EXP RX port receives an optical signal from another 40-WSS-C or 40-WSS-CE card in the same NE. • EXP TX: The EXP TX port sends an optical signal to the other 40-WSS-C or 40-WSS-CE card within the NE. • DROP TX port: The DROP TX port sends the split off optical signal that contains drop channels to the 40-DMX-C(or 40-DMX-CE) card, where the channels are further processed and dropped. "The following figure shows a functional block diagram of the 40-WSS-C or 40-WSS-CE card: Figure 3: 40-WSS-C or 40-WSS-CE Block Diagram:" According to Cisco's NCS 2000 Data Sheet 2, Cisco's ROADM includes an input port for an input multi-wavelength optical signal having first spectral channels as follows: "The Cisco 16-port Flex Spectrum ROADM Line Card (16-WXC-FS) is a double-slot unit that provides multidegree switching capabilities not only at the individual wavelength level but also with flexible spectrum allocations. You can use the 16-port Flex Spectrum ROADM Line Card in the core of the

	network to build ROADM nodes with 96 channels spaced at 50-GHz, FlexSpectrum channels, or a combination of the two. By using a simple software reconfiguration, the same unit can provide colorless multiplexing and demultiplexing to ROADM nodes." Figure 4 of Cisco's NCS 2000 Data Sheet 2 provides a picture of the "16-port Flex Spectrum ROADM Line Card N-Degree ROADM Layout," which includes several WSS devices that include an input port for an input multi-wavelength optical signal having first spectral channels as follows: 
one or more other ports for second spectral channels;	Cisco's ROADMs include one or more other ports for second spectral channels. As shown in Cisco's ROADM Configuration Chapter about provisioning reconfigurable optical add/drop cards, Cisco's ROADM includes one or more other ports for second spectral channels as follows:

	"The 40-WSS-C or 40-WSS-CE has eight types of ports: • ADD RX ports (1 to 40): These ports are used for adding channels. Each add channel is associated with an individual switch element that selects whether an individual channel is added. Each add port has optical power regulation provided by a VOA. The five connectors on the card faceplate accept MPO cables for the client input interfaces. MPO cables break out into eight separate cables. The 40-WSS-C or 40-WSS-CE card also has one LC-PC-II optical connector for the main input. • COM RX: The COM RX port receives the optical signal from a preamplifier (such as the OPT-PRE) and sends it to the optical splitter. • COM TX: The COM TX port sends an aggregate optical signal to a booster amplifier card (for example, the OPT-BST card) for transmission outside of the NE. • EXP RX port: The EXP RX port receives an optical signal from another 40-WSS-C or 40-WSS-CE card in the same NE. • EXP TX: The EXP TX port sends an optical signal to the other 40-WSS-C or 40-WSS-CE card within the NE. • DROP TX port: The DROP TX port sends the split off optical signal that contains drop channels to the 40-DMX-C(or 40-DMX-CE) card, where the channels are further processed and dropped. "The following figure shows a functional block diagram of the 40-WSS-C or 40-WSS-CE card: Figure 3: 40-WSS-C or 40-WSS-CE Block Diagram:" According to Cisco's NCS 2000 Data Sheet 2, Cisco's ROADM includes one or more other ports for second spectral channels as follows: "The Cisco 16-port Flex Spectrum ROADM Line Card (16-WXC-FS) is a double-slot unit that provides multidegree switching capabilities not only at the individual wavelength level but also with flexible spectrum allocations. You can use the 16-port Flex Spectrum ROADM Line Card in the core of the network to build ROADM nodes with 96 channels spaced at 50-GHz, FlexSpectrum channels, or a combination of the two. By using a simple software reconfiguration, the same unit can provide colorless multiplexing and demultiplexing to ROADM nodes." Figure 4 of Cisco's NCS 2000 Data Sheet 2 provides a picture of the "16-port Flex Spectrum ROADM Line Card N-Degree ROADM Layout," which includes several WSS devices that include one or more other ports for second spectral channels as follows:

	
an output port for an output multi-wavelength optical signal;	Cisco's ROADMs include an output port for an output multi-wavelength optical signal. As shown in Cisco's ROADM Configuration Chapter about provisioning reconfigurable optical add/drop cards, Cisco's ROADM includes an output port for an output multi-wavelength optical signal: "The 40-WSS-C or 40-WSS-CE has eight types of ports: • ADD RX ports (1 to 40): These ports are used for adding channels. Each add channel is associated with an individual switch element that selects whether an individual channel is added. Each add port has optical power regulation provided by a VOA. The five connectors on the card faceplate accept MPO cables for the client input interfaces. MPO cables break out into eight separate cables. The 40-WSS-C or 40-WSS-CE card also has one LC-PC-II optical connector for the main input. • COM RX: The COM RX port receives the optical signal from a preamplifier (such as the OPT-PRE) and

	sends it to the optical splitter. • COM TX: The COM TX port sends an aggregate optical signal to a booster amplifier card (for example, the OPT-BST card) for transmission outside of the NE. • EXP RX port: The EXP RX port receives an optical signal from another 40-WSS-C or 40-WSS-CE card in the same NE. • EXP TX: The EXP TX port sends an optical signal to the other 40-WSS-C or 40-WSS-CE card within the NE. • DROP TX port: The DROP TX port sends the split off optical signal that contains drop channels to the 40-DMX-C(or 40-DMX-CE) card, where the channels are further processed and dropped. "The following figure shows a functional block diagram of the 40-WSS-C or 40-WSS-CE card: Figure 3: 40-WSS-C or 40-WSS-CE Block Diagram:" According to Cisco's NCS 2000 Data Sheet 2, Cisco's ROADM includes an output port for an output multi-wavelength optical signal as follows: "The Cisco 16-port Flex Spectrum ROADM Line Card (16-WXC-FS) is a double-slot unit that provides multidegree switching capabilities not only at the individual wavelength level but also with flexible spectrum allocations. You can use the 16-port Flex Spectrum ROADM Line Card in the core of the network to build ROADM nodes with 96 channels spaced at 50-GHz, FlexSpectrum channels, or a combination of the two. By using a simple software reconfiguration, the same unit can provide colorless multiplexing and demultiplexing to ROADM nodes." Figure 4 of Cisco's NCS 2000 Data Sheet 2 provides a picture of the "16-port Flex Spectrum ROADM Line Card N-Degree ROADM Layout," which includes several WSS devices that include an output port for an output multi-wavelength optical signal as follows:

	
a wavelength-selective device for spatially separating said spectral channels;	The Cisco ROADMs include a wavelength-selective device for spatially separating said spectral channels. According to Cisco's Data Sheets and website, Cisco's ROADM products include a WSS-based card ("switching module"). The switching module includes a a wavelength-selective device for spatially separating said spectral channels.
a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements	The Cisco ROADMs include a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said ports and to control the power of the spectral channel reflected to said selected port.

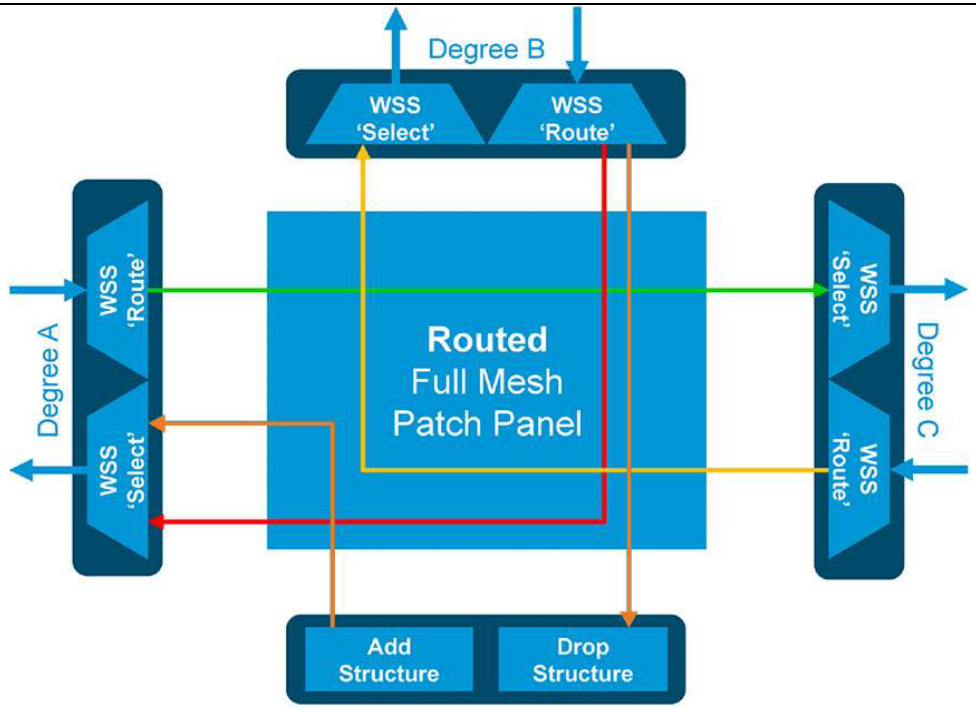
being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said ports and to control the power of the spectral channel reflected to said selected port.	According to Cisco's Data Sheets and website, Cisco's ROADM products include a WSS-based card ("switching module"). The switching module includes a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said ports and to control the power of the spectral channel reflected to said selected port. According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide complete ROADM functionality and allow for the adding, dropping, multiplexing, switching, and routing of signals on an individual wavelength level. According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide ROADM functionality as follows: "The 40-WSS-C (or 40-WSS-CE) card works in combination with the 40-DMX-C (or 40-DMX-CE) card to implement ROADM functionality. As a ROADM node, the node can be configured at the optical channel level using CTC, Cisco Transport Planner, and CTM. ROADM functionality using the 40-WSS-C (or 40-WSS-CE) card requires two 40-WSS-C (or 40-WSS-CE) double-slot cards and two 40-DMX-C (or 40-DMX-CE) single-slot cards (for a total of six slots in the chassis)." According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide power monitoring functionality as follows: "The 40-WSS-C (or 40-WSS-CE) has physical diodes that monitor power at various locations on the card. The following table lists the physical diode descriptions." Cisco's ONS 15454 Data Sheet also states that it's 40-WXC-C component in its ROADM devices use "MEMS," which are micro-electromechanical mirrors, to switch (route/add/drop/attenuate/etc.) the signals.
2. The optical add-drop apparatus of claim 1 further comprising a control unit for	The Cisco ROADMs described in claim 1 further include a control unit for controlling each of said beam-deflecting elements. As set forth in Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide "per-channel optical

controlling each of said beam-deflecting elements.	power monitoring using photodiodes" and "aggregate DWDM signal monitoring and control through a variable optical attenuator." In Cisco's ONS 15454 Data Sheet, Cisco describes the control unit mechanism in its ROADM by explaining the dynamic control capabilities of its product as follows: "Embedded automatic power control mechanisms allow interfacing with different types of DWDM units without requiring external attenuators. Used in conjunction with Cisco ONS multiplexers and demultiplexers, these mechanisms allow the management of local add/drop traffic in the specific direction supported by the 80-WXC-C unit. "The Cisco ONS 15454 80-WXC-C card operates on the ITU 50-GHz wavelength plan. The card integrates automatic per-channel power monitor and control capabilities, providing node- and network-based automatic-power-level management on each input and output port. Per-channel optical path selection is also done in a completely automated way through Wavelength Path Provisioning (WPP) at the network level, featuring end-to-end, point-and-click wavelength provisioning and easy SONET/SDH-like wavelength management." Cisco's ONS 15454 Data Sheet also states that it's 40-WXC-C component in its ROADM devices use "MEMS," which are micro-electromechanical mirrors, to switch (route/add/drop/attenuate/etc.) the signals.
3. The optical add-drop apparatus of claim 2, wherein the control unit further comprises a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power	The control unit of the Cisco ROADMs described in claim 2 further includes a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements. As set forth in Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide "per-channel optical power monitoring using photodiodes" and "aggregate DWDM signal monitoring and control through a variable optical attenuator." In Cisco's ONS 15454 Data Sheet, Cisco describes the servo-control mechanism in its ROADM by explaining the dynamic control capabilities of its product as follows: "Embedded automatic power control mechanisms allow interfacing with different types of DWDM units

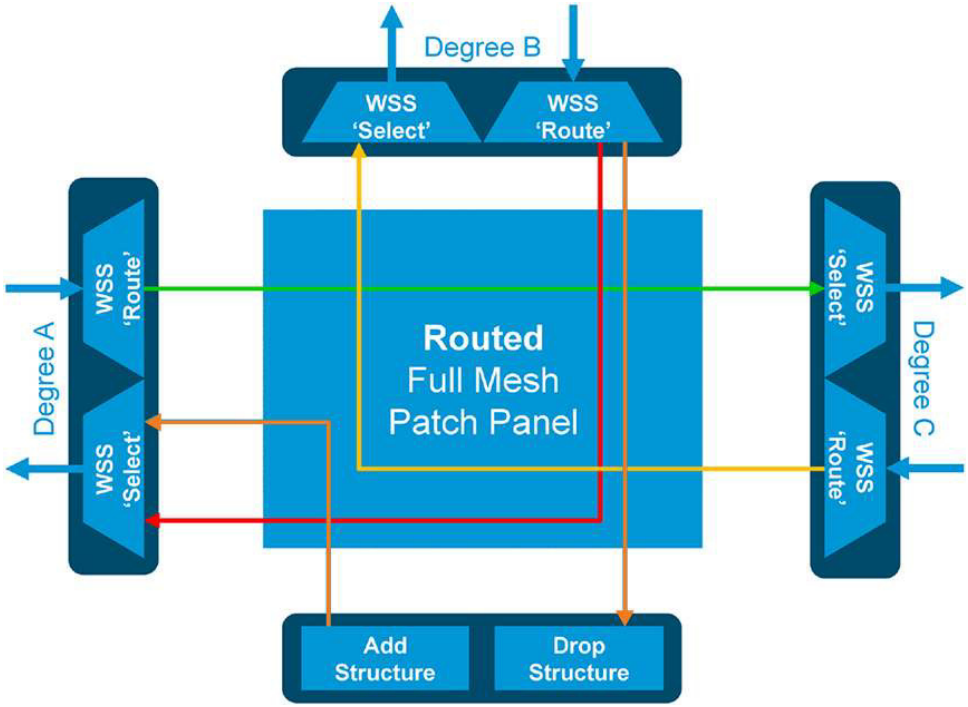
levels for controlling said beam-deflecting elements.	without requiring external attenuators. Used in conjunction with Cisco ONS multiplexers and demultiplexers, these mechanisms allow the management of local add/drop traffic in the specific direction supported by the 80-WXC-C unit. "The Cisco ONS 15454 80-WXC-C card operates on the ITU 50-GHz wavelength plan. The card integrates automatic per-channel power monitor and control capabilities, providing node- and network-based automatic-power-level management on each input and output port. Per-channel optical path selection is also done in a completely automated way through Wavelength Path Provisioning (WPP) at the network level, featuring end-to-end, point-and-click wavelength provisioning and easy SONET/SDH-like wavelength management." Cisco's ONS 15454 Data Sheet also states that it's 40-WXC-C component in its ROADM devices use "MEMS," which are micro-electromechanical mirrors, to switch (route/add/drop/attenuate/etc.) the signals.
4. The optical add-drop apparatus of claim 3, wherein said servo-control assembly maintains said power levels at predetermined values.	The servo-control assembly of the Cisco ROADMs described in claim 3 also maintains power levels at predetermined values. As set forth in Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide "per-channel optical power monitoring using photodiodes" and "aggregate DWDM signal monitoring and control through a variable optical attenuator." In Cisco's ONS 15454 Data Sheet, Cisco describes the servo-control mechanism in its ROADM by explaining the dynamic control capabilities of its product as follows: "Embedded automatic power control mechanisms allow interfacing with different types of DWDM units without requiring external attenuators. Used in conjunction with Cisco ONS multiplexers and demultiplexers, these mechanisms allow the management of local add/drop traffic in the specific direction supported by the 80-WXC-C unit. "The Cisco ONS 15454 80-WXC-C card operates on the ITU 50-GHz wavelength plan. The card integrates automatic per-channel power monitor and control capabilities, providing node- and network-based automatic-power-level management on each input and output port. Per-channel optical path selection is also done in a completely automated way through Wavelength Path Provisioning (WPP) at the network level,

	featuring end-to-end, point-and-click wavelength provisioning and easy SONET/SDH-like wavelength management."
5. The optical add-drop apparatus of claim 2, wherein the control unit controls said beam-deflecting elements to direct selected ones of said first spectral channels to one or more of said second ports to be dropped as second spectral channels from said output multi-wavelength optical signal.	The control unit of Cisco's ROADMs described in claim 2 controls said beam-deflecting elements to direct selected ones of said first spectral channels to one or more of said second ports to be dropped as second spectral channels from said output multi-wavelength optical signal. According to Cisco's Website, its various Data Sheets, and its other materials describing its ROADM Products' functionality, Cisco's ROADMs include a switching module that is WSS-based. The switching module includes a control unit and beam deflecting elements to direct selected ones of said first spectral channels to one or more of said second ports to be dropped as second spectral channels from said output multi-wavelength optical signal. As shown in Cisco's ROADM Configuration Chapter about provisioning reconfigurable optical add/drop cards, Cisco's ROADM includes a WSS that can direct spectral channels to with various ports, including input and output ports, as follows: "The 40-WSS-C or 40-WSS-CE has eight types of ports: • ADD RX ports (1 to 40): These ports are used for adding channels. Each add channel is associated with an individual switch element that selects whether an individual channel is added. Each add port has optical power regulation provided by a VOA. The five connectors on the card faceplate accept MPO cables for the client input interfaces. MPO cables break out into eight separate cables. The 40-WSS-C or 40-WSS-CE card also has one LC-PC-II optical connector for the main input. • COM RX: The COM RX port receives the optical signal from a preamplifier (such as the OPT-PRE) and sends it to the optical splitter. • COM TX: The COM TX port sends an aggregate optical signal to a booster amplifier card (for example, the OPT-BST card) for transmission outside of the NE. • EXP RX port: The EXP RX port receives an optical signal from another 40-WSS-C or 40-WSS-CE card in the same NE. • EXP TX: The EXP TX port sends an optical signal to the other 40-WSS-C or 40-WSS-CE card within the NE. • DROP TX port: The DROP TX port sends the split off optical signal that contains drop channels to the 40-DMX-C(or 40-DMX-CE) card, where the channels are further processed and dropped.

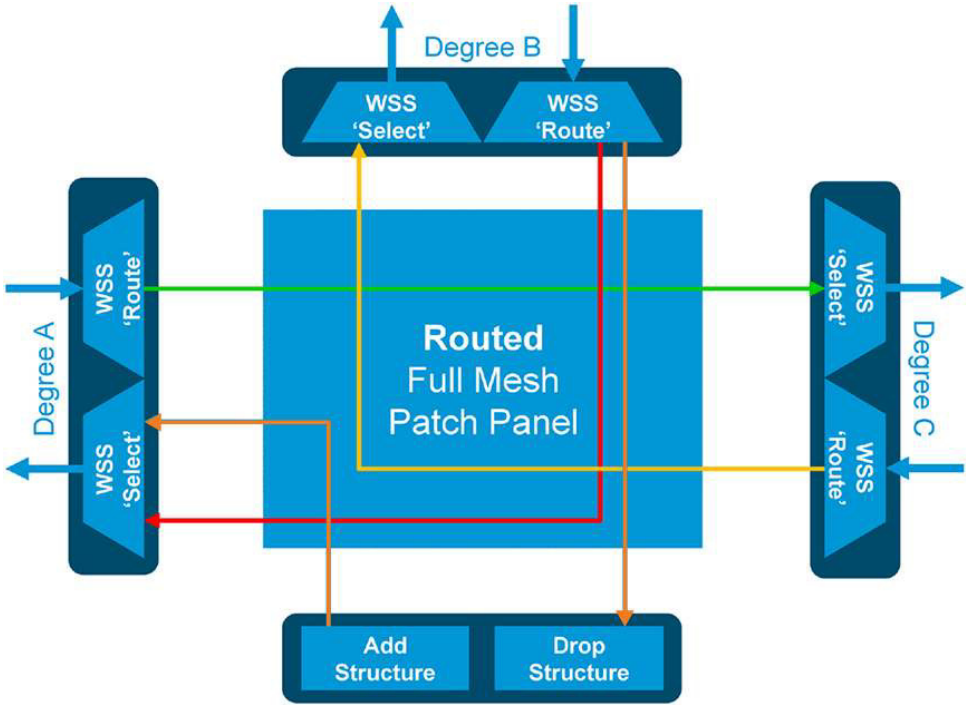
	"The following figure shows a functional block diagram of the 40-WSS-C or 40-WSS-CE card: Figure 3: 40-WSS-C or 40-WSS-CE Block Diagram:" According to Cisco's NCS 2000 Data Sheet 2, Cisco's ROADM includes a WSS that can direct spectral channels to with various ports, including input and output ports, as follows: "The Cisco 16-port Flex Spectrum ROADM Line Card (16-WXC-FS) is a double-slot unit that provides multidegree switching capabilities not only at the individual wavelength level but also with flexible spectrum allocations. You can use the 16-port Flex Spectrum ROADM Line Card in the core of the network to build ROADM nodes with 96 channels spaced at 50-GHz, FlexSpectrum channels, or a combination of the two. By using a simple software reconfiguration, the same unit can provide colorless multiplexing and demultiplexing to ROADM nodes." Figure 4 of Cisco's NCS 2000 Data Sheet 2 provides a picture of the "16-port Flex Spectrum ROADM Line Card N-Degree ROADM Layout," which includes WSSs that can direct spectral channels to with various ports, including input and output ports, as follows:

	
6. The optical add-drop apparatus of claim 2, wherein the control unit controls said beam-deflecting elements to direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal.	The control unit of Cisco's ROADMs described in claim 2 controls said beam-deflecting elements to direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal. According to Cisco's Website, its various Data Sheets, and its other materials describing its ROADM Products' functionality, Cisco's ROADMs include a switching module that is WSS-based. The switching module includes a control unit and beam deflecting elements. The control unit controls the beam-deflecting elements to direct certain spectral channels to an output port to be added to said output multi-wavelength optical signal. As shown in Cisco's ROADM Configuration Chapter about provisioning reconfigurable optical add/drop cards, Cisco's ROADM includes a WSS that can direct spectral channels to with various ports, including input and output ports, as follows:

	"The 40-WSS-C or 40-WSS-CE has eight types of ports: • ADD RX ports (1 to 40): These ports are used for adding channels. Each add channel is associated with an individual switch element that selects whether an individual channel is added. Each add port has optical power regulation provided by a VOA. The five connectors on the card faceplate accept MPO cables for the client input interfaces. MPO cables break out into eight separate cables. The 40-WSS-C or 40-WSS-CE card also has one LC-PC-II optical connector for the main input. • COM RX: The COM RX port receives the optical signal from a preamplifier (such as the OPT-PRE) and sends it to the optical splitter. • COM TX: The COM TX port sends an aggregate optical signal to a booster amplifier card (for example, the OPT-BST card) for transmission outside of the NE. • EXP RX port: The EXP RX port receives an optical signal from another 40-WSS-C or 40-WSS-CE card in the same NE. • EXP TX: The EXP TX port sends an optical signal to the other 40-WSS-C or 40-WSS-CE card within the NE. • DROP TX port: The DROP TX port sends the split off optical signal that contains drop channels to the 40-DMX-C(or 40-DMX-CE) card, where the channels are further processed and dropped. "The following figure shows a functional block diagram of the 40-WSS-C or 40-WSS-CE card: Figure 3: 40-WSS-C or 40-WSS-CE Block Diagram:" According to Cisco's NCS 2000 Data Sheet 2, Cisco's ROADM includes a WSS that can direct spectral channels to with various ports, including input and output ports, as follows: "The Cisco 16-port Flex Spectrum ROADM Line Card (16-WXC-FS) is a double-slot unit that provides multidegree switching capabilities not only at the individual wavelength level but also with flexible spectrum allocations. You can use the 16-port Flex Spectrum ROADM Line Card in the core of the network to build ROADM nodes with 96 channels spaced at 50-GHz, FlexSpectrum channels, or a combination of the two. By using a simple software reconfiguration, the same unit can provide colorless multiplexing and demultiplexing to ROADM nodes." Figure 4 of Cisco's NCS 2000 Data Sheet 2 provides a picture of the "16-port Flex Spectrum ROADM Line Card N-Degree ROADM Layout," which includes WSSs that can direct spectral channels to with

	various ports, including input and output ports, as follows:  Cisco's ONS 15454 Data Sheet also states that it's 40-WXC-C component in its ROADM devices use "MEMS," which are micro-electromechanical mirrors, to switch (route/add/drop/attenuate/etc.) the signals.
9. The optical add-drop apparatus of claim 1, wherein said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting	Cisco's ROADMs as described in claim 1 uses the wavelength selective device further to combine selected ones of said spectral channels reflected from said beam-deflecting elements to form said output multi-wavelength optical signal. According to Cisco's Website, its various Data Sheets, and its other materials describing its ROADM Products' functionality, Cisco's ROADMs include a switching module that is WSS-based. The switching module includes a control unit and beam deflecting elements. The control unit controls the beam-deflecting elements to direct certain spectral channels to certain output ports to be added to said output multi-

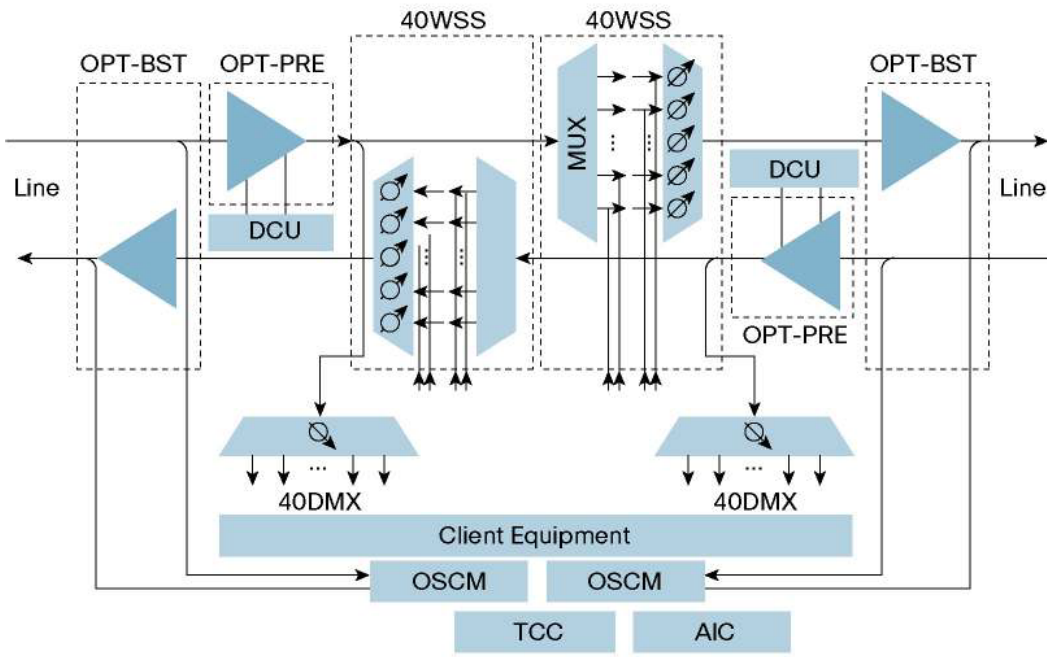
elements to form said output multi-wavelength optical signal.	wavelength optical signal. As shown in Cisco's ROADM Configuration Chapter about provisioning reconfigurable optical add/drop cards, Cisco's ROADM includes a WSS that can direct spectral channels to with various ports, including input and output ports, as follows: "The 40-WSS-C or 40-WSS-CE has eight types of ports: • ADD RX ports (1 to 40): These ports are used for adding channels. Each add channel is associated with an individual switch element that selects whether an individual channel is added. Each add port has optical power regulation provided by a VOA. The five connectors on the card faceplate accept MPO cables for the client input interfaces. MPO cables break out into eight separate cables. The 40-WSS-C or 40-WSS-CE card also has one LC-PC-II optical connector for the main input. • COM RX: The COM RX port receives the optical signal from a preamplifier (such as the OPT-PRE) and sends it to the optical splitter. • COM TX: The COM TX port sends an aggregate optical signal to a booster amplifier card (for example, the OPT-BST card) for transmission outside of the NE. • EXP RX port: The EXP RX port receives an optical signal from another 40-WSS-C or 40-WSS-CE card in the same NE. • EXP TX: The EXP TX port sends an optical signal to the other 40-WSS-C or 40-WSS-CE card within the NE. • DROP TX port: The DROP TX port sends the split off optical signal that contains drop channels to the 40-DMX-C(or 40-DMX-CE) card, where the channels are further processed and dropped. "The following figure shows a functional block diagram of the 40-WSS-C or 40-WSS-CE card: Figure 3: 40-WSS-C or 40-WSS-CE Block Diagram:" According to Cisco's NCS 2000 Data Sheet 2, Cisco's ROADM includes a WSS that can direct spectral channels to with various ports, including input and output ports, as follows: "The Cisco 16-port Flex Spectrum ROADM Line Card (16-WXC-FS) is a double-slot unit that provides multidegree switching capabilities not only at the individual wavelength level but also with flexible spectrum allocations. You can use the 16-port Flex Spectrum ROADM Line Card in the core of the network to build ROADM nodes with 96 channels spaced at 50-GHz, FlexSpectrum channels, or a

	combination of the two. By using a simple software reconfiguration, the same unit can provide colorless multiplexing and demultiplexing to ROADM nodes." Figure 4 of Cisco's NCS 2000 Data Sheet 2 provides a picture of the "16-port Flex Spectrum ROADM Line Card N-Degree ROADM Layout," which includes WSSs that can direct spectral channels to with various ports, including input and output ports, as follows:  Cisco's ONS 15454 Data Sheet also states that it's 40-WXC-C component in its ROADM devices use "MEMS," which are micro-electromechanical mirrors, to switch (route/add/drop/attenuate/etc.) the signals.
10. The optical add-drop apparatus of claim 1, wherein said one or	The one or more other ports in Cisco's ROADMs as described in claim 1 comprise an add port and a drop port for respectively adding second and dropping first spectral channels.

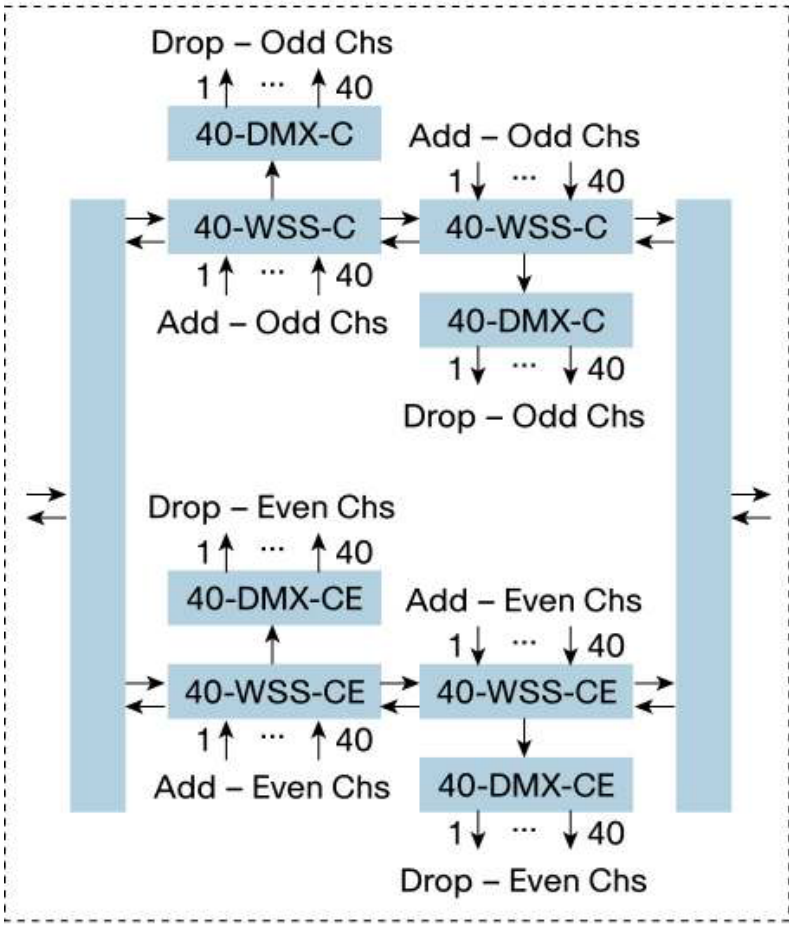
more other ports comprise an add port and a drop port for respectively adding second and dropping first spectral channels.	Cisco's Website and ROADM Datasheet state that Cisco's ROADM products "[d]eliver[] on-demand high bandwidth services, any port to any port." Cisco's ROADM Powerpoint explains a variety of DWDM and combination switch routing solutions wherein said one or more other ports comprise an add port and a drop port for respectively adding second and dropping first spectral channels.
11. The optical add-drop apparatus of claim 1 further comprising a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements.	The Cisco ROADMs include a beam-focuser, for focusing said spectral channels into corresponding spectral spots. According to Cisco's Data Sheets and website, Cisco's ROADM products include a WSS-based card ("switching module"). The switching module includes a beam-focuser, for focusing said spectral channels into corresponding spectral spots. Cisco's ONS 15454 Data Sheet also states that it's 40-WXC-C component in its ROADM devices use "MEMS," which are micro-electromechanical mirrors, to switch (route/add/drop/attenuate/etc.) the signals.
12. The optical add-drop apparatus of claim 1, wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms.	Cisco's ROADMs include switching modules that include diffraction gratings. The diffraction grating that Cisco uses in its ROADMs can be a ruled diffraction grating, an halographic diffraction grating, an echelle grating, a curved diffraction grating, or a dispersing grating.
15. An optical add-drop apparatus, comprising	Cisco makes, uses, sells, imports, and/or offers to sell reconfigurable optical add drop multiplexers ("ROADMs") and other products that incorporate wavelength selective switches ("WSSs"), each of which

	is a wavelength separating-routing apparatus. Cisco makes, uses, sells, imports, and/or offers to sell reconfigurable optical add drop multiplexers ("ROADMs") and other products that incorporate wavelength selective switches ("WSSs"), each of which is a wavelength separating-routing apparatus. Several documents detail the functionality of Cisco's ROADM products, including: • "Data Sheet: 40-Channel Reconfigurable Optical Add/Drop Multiplexing Portfolio for the Cisco ONS 15454 Multiservice Transport Platform," dated 1992-2007 ("ONS 15454 Data Sheet"); • "Data Sheet: Cisco NCS 2000 Service Line Cards," dated 2013 ("NCS 2000 Data Sheet 1"); • "Data Sheet: Cisco Network Convergence System 2000 ROADM and Amplifier Line Cards," dated 2013 ("NCS 2000 Data Sheet 2"); • "Cisco ONS 15200 Series DWDM Systems," from Cisco's website (www.cisco.com/c/en/us/products/optical-networking/ons-15200-series-dwdm-systems/index.html) ("ONS 15200 Webpage"); • "Data Sheet: Cisco ONS 15216 C L-Band Splitter/Combiner Module for Cisco ONS 15454 MSTP" dated 1992-2005 ("ONS 15200 Data Sheet"); • "Cisco NCS 2002 and NCS 2006 Line Card Configuration Guide, Release 10.x.x," chapter titled "Provisioning Reconfigurable Optical Add/Drop Cards," which "describes the line cards deployed in reconfigurable optical add/drop (ROADM) networks," pp12-16, which focus on the "40-WSS-C and 40-WSS-CE Card," and pp 31-38, which focus on "Single Module ROADM (SMR-C) Cards" ("ROADM Configuration Chapter"); and • information and documents available from Cisco's website (www.cisco.com) ("Website"). According to Cisco's ONS 15454 Data Sheet: "The Cisco® ONS 15454 Multiservice Transport Platform (MSTP) (Figure 1) provides a comprehensive, intelligent dense wavelength-division multiplexing (DWDM) solution for expanding metropolitan (metro) and regional bandwidth." Figure 1 is labeled as "40-Channel Wavelength Cross-Connect (40-WXC), Wavelength Selective Switch (40-WSS), Multiplexer (40-MUX), and Demultiplexer (40-DMX) Units." "While Wavelength Selective Switch (WSS) units provide degree-2 type reconfigurability (drop

	wavelength in a node vs. let it pass through the node), an ROADM node based on 40-WXC units can support up to degree-8 reconfigurability. This means that for each wavelength it is possible to decide if it has to be locally dropped or routed to any of the other 7 pass-through directions of the node. Such a capability not only enhances the flexibility of the DWDM transport network but also dramatically reduces the need for costly transponders to perform optical-to-electrical-to-optical conversion (typically 2 transponders/crossponders per add/drop channel or wavelength)." "As even in complex mesh network topologies it is likely that degree-2 reconfigurability would be enough for most of the node, the 40-channel ROADM portfolio includes also two different versions of the 40-WSS units, one operating on the odd channels of the C band spectrum (40-WSS-C) and the other one operating on the even channels of the C band spectrum (40-WSS-CE). The units can be used in conjunction with existing 32-channel ROADM solutions and with 40-WXC units to provide the greatest degree of flexibility for Cisco ONS 15454 MSTP deployments." "Embedded automatic power control mechanisms feature the possibility to interface with different types of DWDM units without requiring external attenuators. Used in conjunction with the 40-channel Multiplexer and 40-channel Demultiplexer allows to manage local add/drop traffic of the specific direction supported by the 40-WXC unit." "Embedded automatic power control mechanisms feature the possibility to interface with different type of DWDM units without requiring external attenuators." A chart in Cisco's ONS 15454 Data Sheet lists the components within the 40-Channel ROADM Units, including a "40-Channel Wavelength Selective Switch" The following figure 3 from Cisco's ONS 15454 Data Sheet is a chart of the "MSTP 40-Channel Degree-2 ROADM Node" and shows how wavelength selective switches (labeled "WSS") are integrated within a Cisco's ROADM:



The following figure 4 from Cisco's ONS 15454 Data Sheet is a chart of the "MSTP 80-Channel Degree-2 ROADM Node" and shows how wavelength selective switches (labeled "WSS") are integrated within a Cisco's ROADM and how Cisco's ROADM can add and drop signals:

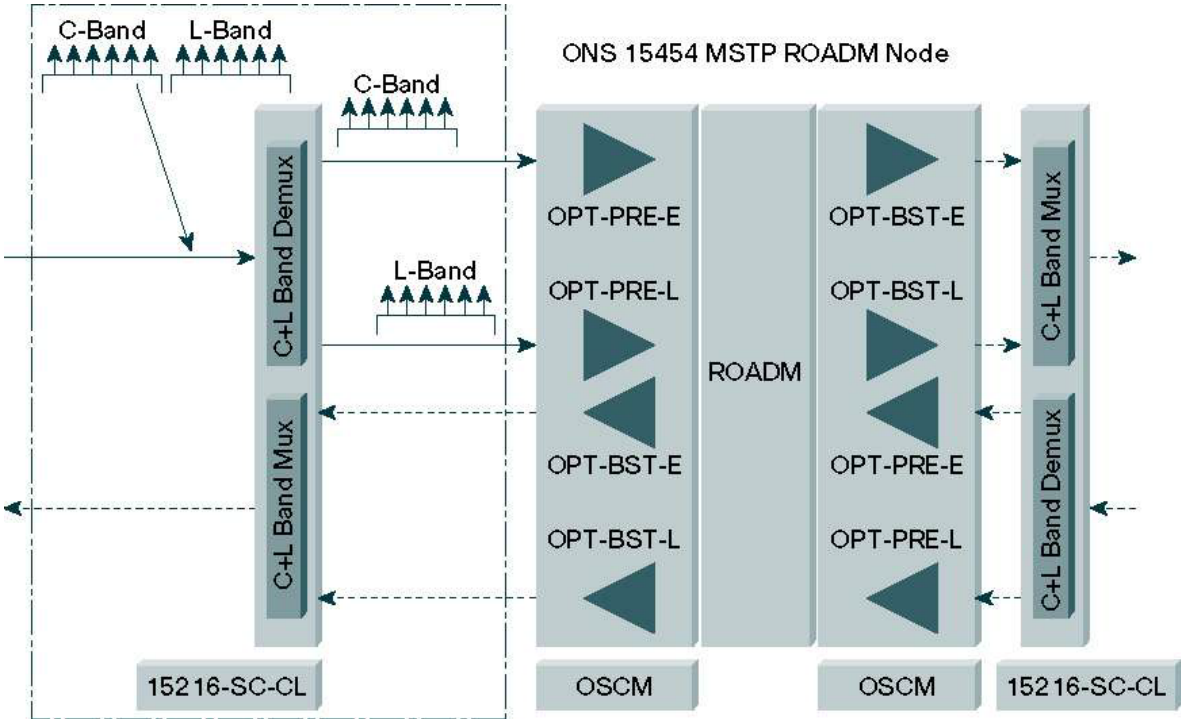


According to Cisco's ONS 15200 Data Sheet and ONS 15200 Webpage, both of which describe the ONS 15200 series of Cisco products, the ONS 15216 is the front end to the WSS ROADM in the ONS 15454. The ONS 15216 and ONS 15454 are integral to one another, so the ONS 15216 cannot work without the ONS 15454 and vice versa.

According to Cisco's ONS 15200 Webpage, "Cisco ONS 15200 Series DWDM Systems consist of

intuitive, compact, passive devices used in a variety of applications. These range from low latency, point-to-point data center interconnect to passive or reconfigurable optical add/drop multiplexer- (ROADM) based metropolitan rings."

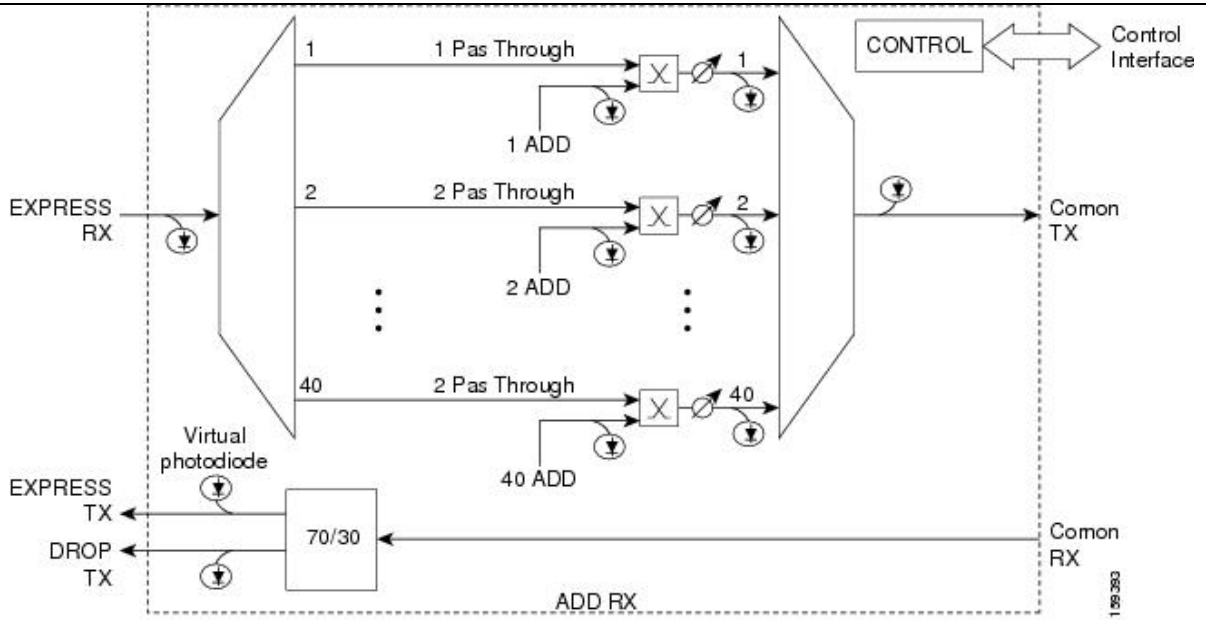
According to Cisco's ONS 15200 Data Sheet, Figure 3 describes "Cisco ONS 15216 C+L-Band Splitter/Combiner Module Deployed in a Cisco ONS 15454 MSTP ROADM Node" and depicts the relationship of Cisco's 15200 series products with Cisco's 15454 ROADM as follows:



According to Cisco's ROADM Configuration Chapter, the Single Module ROADM (SMR-C) Cards are "single-slot 40-channel single module ROADM (SMR-C) cards" and they "integrate the following functional blocks onto a single line card:
"• Optical preamplifier
• Optical booster amplifier

	• Optical service channel (OSC) filter • 2x1 wavelength cross-connect (WXC) or a 4x1 WXC • Optical channel monitor (OCM)" According to Cisco's ROADM Configuration Chapter, the Single Module ROADM (SMR-C) Cards "can manage up to 40 channels spaced at 100GHz on each port." Cisco's ROADM Configuration Chapter about provisioning reconfigurable optical add/drop cards describes the "40-WSS-C and 40-WSS-CE Card" as follows: "The double-slot 40-channel wavelength selective switch C-band (40-WSS-C) or the double-slot 40-channel wavelength selective switch even-channel C-band (40-WSS-CE) card switches 40 ITU-T 100-GHz-spaced channels identified in the channel plan (Table 4: Channel Allocation Plan or Table 5: Channel Allocation Plan) and sends them to dedicated output ports. The 40-WSS-C or 40-WSS-CE card is bidirectional and optically passive. The card can be installed in Slots 1 to 6 and 12 to 17 "The 40-WSS-C or 40-WSS-CE features include: • Receipt of an aggregate DWDM signal into 40 output optical channels from the Line receive port (EXP RX) in one direction and from the COM-RX port in the other direction. • Per-channel optical power monitoring using photodiodes. • Signal splitting in a 70%-to-30% ratio, sent to the 40-DMX-C (or 40-DMX-CE) for dropping signals, then to the other 40-WSS-C (or 40-WSS-CE) card. • Aggregate DWDM signal monitoring and control through a variable optical attenuator (VOA). In the case of electrical power failure, the VOA is set to its maximum attenuation for safety purposes. A manual VOA setting is also available." "Within the 40-WSS-C or 40-WSS-CE card, the first AWG opens the spectrum and each wavelength is directed to one of the ports of a 1x2 optical switch. The same wavelength can be passed through or stopped. If the pass-through wavelength is stopped, a new channel can be added at the ADD port. The card's second AWG multiplexes all of the wavelengths, and the aggregate signal is output through the COM-TX port." "The 40-WSS-C or 40-WSS-CE has eight types of ports: • ADD RX ports (1 to 40): These ports are used for adding channels. Each add channel is associated with an

	individual switch element that selects whether an individual channel is added. Each add port has optical power regulation provided by a VOA. The five connectors on the card faceplate accept MPO cables for the client input interfaces. MPO cables break out into eight separate cables. The 40-WSS-C or 40-WSS-CE card also has one LC-PC-II optical connector for the main input. • COM RX: The COM RX port receives the optical signal from a preamplifier (such as the OPT-PRE) and sends it to the optical splitter. • COM TX: The COM TX port sends an aggregate optical signal to a booster amplifier card (for example, the OPT-BST card) for transmission outside of the NE. • EXP RX port: The EXP RX port receives an optical signal from another 40-WSS-C or 40-WSS-CE card in the same NE. • EXP TX: The EXP TX port sends an optical signal to the other 40-WSS-C or 40-WSS-CE card within the NE. • DROP TX port: The DROP TX port sends the split off optical signal that contains drop channels to the 40-DMX-C(or 40-DMX-CE) card, where the channels are further processed and dropped. “The following figure shows a functional block diagram of the 40-WSS-C or 40-WSS-CE card: Figure 3: 40-WSS-C or 40-WSS-CE Block Diagram:”



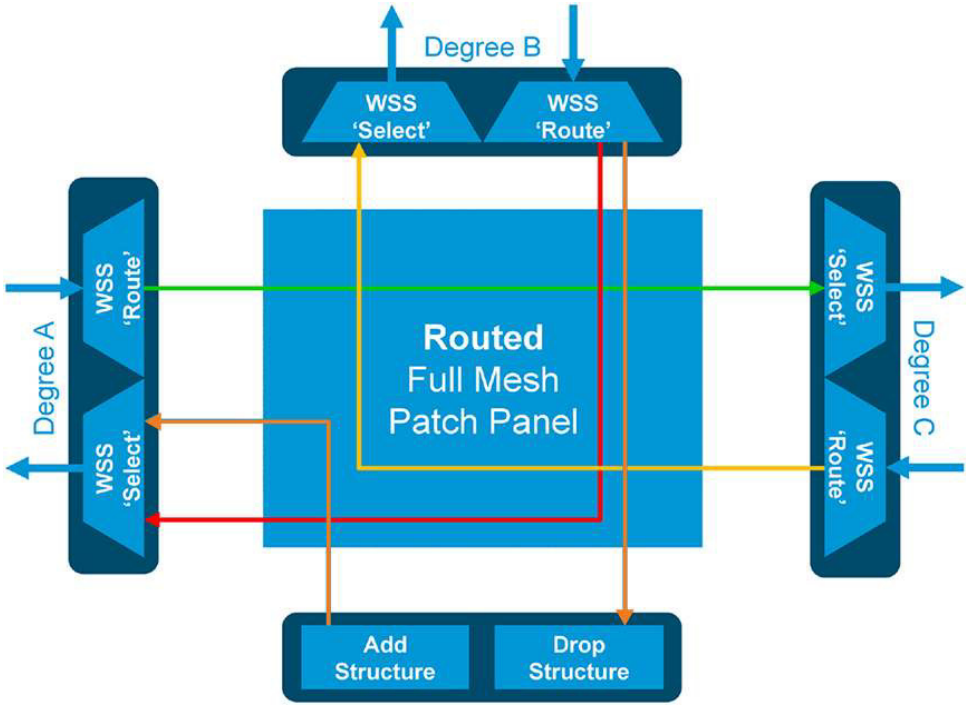
According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide ROADM functionality as follows:

"The 40-WSS-C (or 40-WSS-CE) card works in combination with the 40-DMX-C (or 40-DMX-CE) card to implement ROADM functionality. As a ROADM node, the node can be configured at the optical channel level using CTC, Cisco Transport Planner, and CTM. ROADM functionality using the 40-WSS-C (or 40-WSS-CE) card requires two 40-WSS-C (or 40-WSS-CE) double-slot cards and two 40-DMX-C (or 40-DMX-CE) single-slot cards (for a total of six slots in the chassis)."

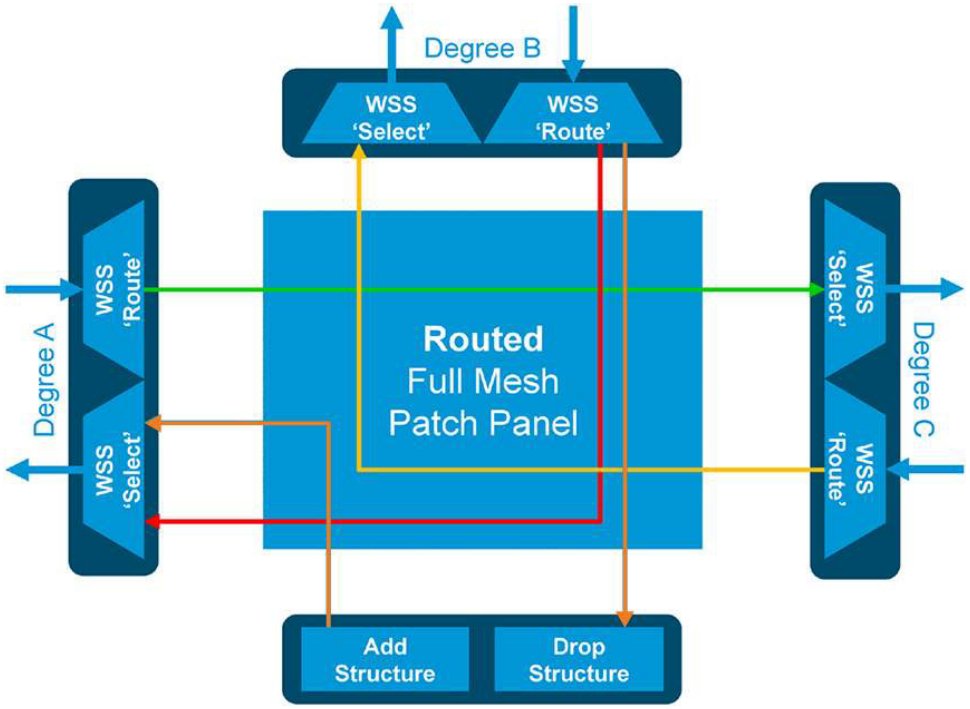
According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide power monitoring functionality as follows:

"The 40-WSS-C (or 40-WSS-CE) has physical diodes that monitor power at various locations on the card. The following table lists the physical diode descriptions."

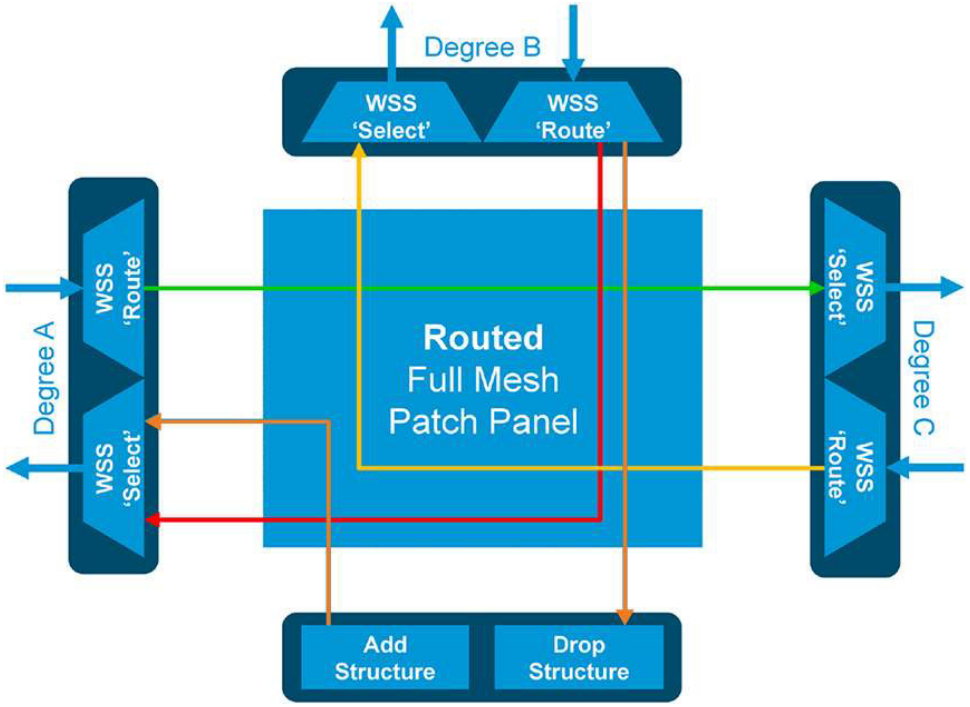
According to Cisco's NCS 2000 Data Sheet 2, Cisco provides a ROADM as follows:

	"The Cisco 16-port Flex Spectrum ROADM Line Card (16-WXC-FS) is a double-slot unit that provides multidegree switching capabilities not only at the individual wavelength level but also with flexible spectrum allocations. You can use the 16-port Flex Spectrum ROADM Line Card in the core of the network to build ROADM nodes with 96 channels spaced at 50-GHz, FlexSpectrum channels, or a combination of the two. By using a simple software reconfiguration, the same unit can provide colorless multiplexing and demultiplexing to ROADM nodes." Figure 4 of Cisco's NCS 2000 Data Sheet 2 provides a picture of the "16-port Flex Spectrum ROADM Line Card N-Degree ROADM Layout," which includes several WSS devices:  Cisco's ONS 15454 Data Sheet also states that it's 40-WXC-C component in its ROADM devices use "MEMS," which are micro-electromechanical mirrors, to switch (route/add/drop/attenuate/etc.) the signals.

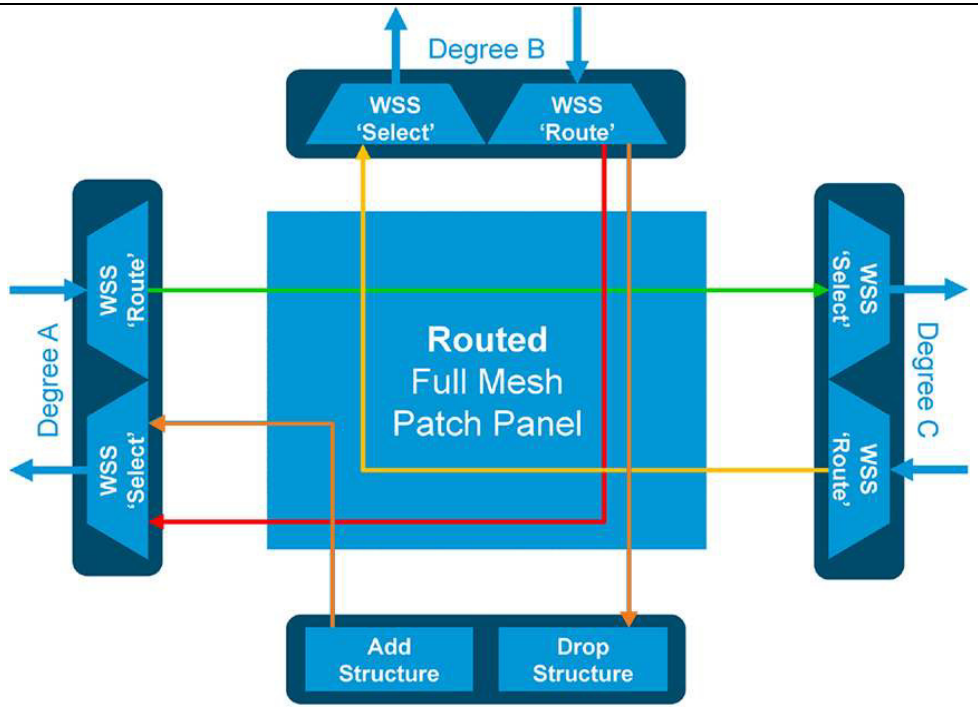
an input port for an input multi-wavelength optical signal having multiple spectral channels;	Cisco's ROADMs include an input port for an input multi-wavelength optical signal having multiple spectral channels. As shown in Cisco's ROADM Configuration Chapter about provisioning reconfigurable optical add/drop cards, Cisco's ROADM includes an input port for an input multi-wavelength optical signal having multiple spectral channels as follows: "The 40-WSS-C or 40-WSS-CE has eight types of ports: • ADD RX ports (1 to 40): These ports are used for adding channels. Each add channel is associated with an individual switch element that selects whether an individual channel is added. Each add port has optical power regulation provided by a VOA. The five connectors on the card faceplate accept MPO cables for the client input interfaces. MPO cables break out into eight separate cables. The 40-WSS-C or 40-WSS-CE card also has one LC-PC-II optical connector for the main input. • COM RX: The COM RX port receives the optical signal from a preamplifier (such as the OPT-PRE) and sends it to the optical splitter. • COM TX: The COM TX port sends an aggregate optical signal to a booster amplifier card (for example, the OPT-BST card) for transmission outside of the NE. • EXP RX port: The EXP RX port receives an optical signal from another 40-WSS-C or 40-WSS-CE card in the same NE. • EXP TX: The EXP TX port sends an optical signal to the other 40-WSS-C or 40-WSS-CE card within the NE. • DROP TX port: The DROP TX port sends the split off optical signal that contains drop channels to the 40-DMX-C(or 40-DMX-CE) card, where the channels are further processed and dropped. "The following figure shows a functional block diagram of the 40-WSS-C or 40-WSS-CE card: Figure 3: 40-WSS-C or 40-WSS-CE Block Diagram:" According to Cisco's NCS 2000 Data Sheet 2, Cisco's ROADM includes an input port for an input multi-wavelength optical signal having multiple spectral channels as follows: "The Cisco 16-port Flex Spectrum ROADM Line Card (16-WXC-FS) is a double-slot unit that provides multidegree switching capabilities not only at the individual wavelength level but also with flexible spectrum allocations. You can use the 16-port Flex Spectrum ROADM Line Card in the core of the

	network to build ROADM nodes with 96 channels spaced at 50-GHz, FlexSpectrum channels, or a combination of the two. By using a simple software reconfiguration, the same unit can provide colorless multiplexing and demultiplexing to ROADM nodes." Figure 4 of Cisco's NCS 2000 Data Sheet 2 provides a picture of the "16-port Flex Spectrum ROADM Line Card N-Degree ROADM Layout," which includes several WSS devices that include an input port for an input multi-wavelength optical signal having multiple spectral channels as follows: 
an output port for an output multi-wavelength optical signal;	Cisco's ROADMs include an output port for an output multi-wavelength optical signal. As shown in Cisco's ROADM Configuration Chapter about provisioning reconfigurable optical add/drop cards, Cisco's ROADM includes an output port for an output multi-wavelength optical signal:

	"The 40-WSS-C or 40-WSS-CE has eight types of ports: • ADD RX ports (1 to 40): These ports are used for adding channels. Each add channel is associated with an individual switch element that selects whether an individual channel is added. Each add port has optical power regulation provided by a VOA. The five connectors on the card faceplate accept MPO cables for the client input interfaces. MPO cables break out into eight separate cables. The 40-WSS-C or 40-WSS-CE card also has one LC-PC-II optical connector for the main input. • COM RX: The COM RX port receives the optical signal from a preamplifier (such as the OPT-PRE) and sends it to the optical splitter. • COM TX: The COM TX port sends an aggregate optical signal to a booster amplifier card (for example, the OPT-BST card) for transmission outside of the NE. • EXP RX port: The EXP RX port receives an optical signal from another 40-WSS-C or 40-WSS-CE card in the same NE. • EXP TX: The EXP TX port sends an optical signal to the other 40-WSS-C or 40-WSS-CE card within the NE. • DROP TX port: The DROP TX port sends the split off optical signal that contains drop channels to the 40-DMX-C(or 40-DMX-CE) card, where the channels are further processed and dropped. "The following figure shows a functional block diagram of the 40-WSS-C or 40-WSS-CE card: Figure 3: 40-WSS-C or 40-WSS-CE Block Diagram:" According to Cisco's NCS 2000 Data Sheet 2, Cisco's ROADM includes an output port for an output multi-wavelength optical signal as follows: "The Cisco 16-port Flex Spectrum ROADM Line Card (16-WXC-FS) is a double-slot unit that provides multidegree switching capabilities not only at the individual wavelength level but also with flexible spectrum allocations. You can use the 16-port Flex Spectrum ROADM Line Card in the core of the network to build ROADM nodes with 96 channels spaced at 50-GHz, FlexSpectrum channels, or a combination of the two. By using a simple software reconfiguration, the same unit can provide colorless multiplexing and demultiplexing to ROADM nodes." Figure 4 of Cisco's NCS 2000 Data Sheet 2 provides a picture of the "16-port Flex Spectrum ROADM Line Card N-Degree ROADM Layout," which includes several WSS devices that include an output port for an output multi-wavelength optical signal as follows:

	
one or more drop ports for selected spectral channels dropped from said multi-wavelength optical signal;	Cisco's ROADMs include one or more drop ports for selected spectral channels dropped from said multi-wavelength optical signal. As shown in Cisco's ROADM Configuration Chapter about provisioning reconfigurable optical add/drop cards, Cisco's ROADM includes one or more drop ports for selected spectral channels dropped from said multi-wavelength optical signal as follows: "The 40-WSS-C or 40-WSS-CE has eight types of ports: • ADD RX ports (1 to 40): These ports are used for adding channels. Each add channel is associated with an individual switch element that selects whether an individual channel is added. Each add port has optical power regulation provided by a VOA. The five connectors on the card faceplate accept MPO cables for the client input interfaces. MPO cables break out into eight separate cables. The 40-WSS-C or 40-WSS-CE

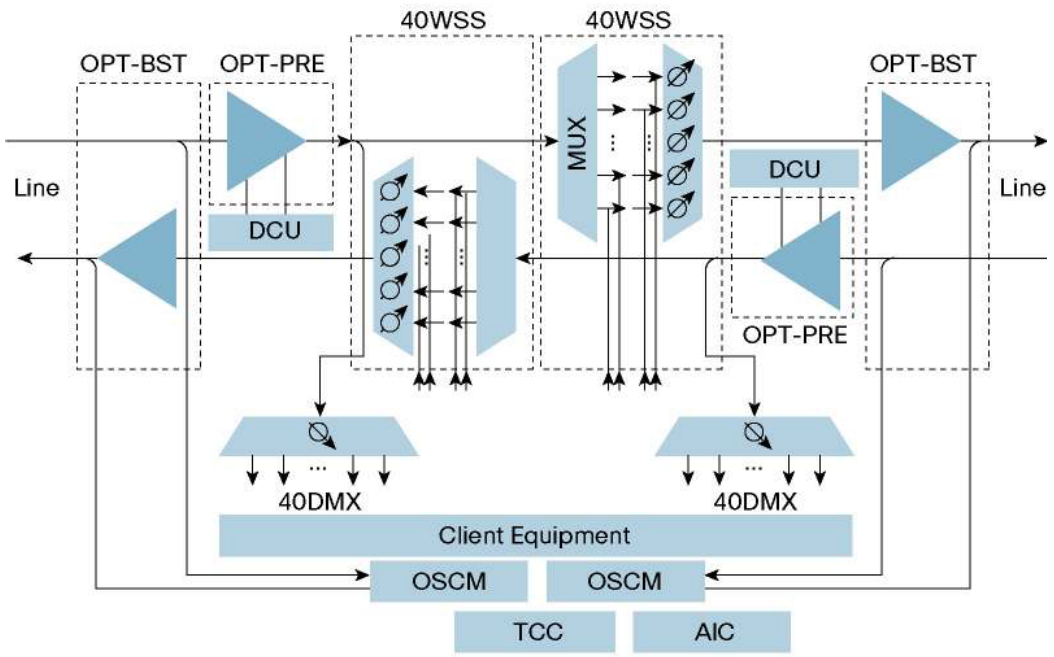
	card also has one LC-PC-II optical connector for the main input. • COM RX: The COM RX port receives the optical signal from a preamplifier (such as the OPT-PRE) and sends it to the optical splitter. • COM TX: The COM TX port sends an aggregate optical signal to a booster amplifier card (for example, the OPT-BST card) for transmission outside of the NE. • EXP RX port: The EXP RX port receives an optical signal from another 40-WSS-C or 40-WSS-CE card in the same NE. • EXP TX: The EXP TX port sends an optical signal to the other 40-WSS-C or 40-WSS-CE card within the NE. • DROP TX port: The DROP TX port sends the split off optical signal that contains drop channels to the 40-DMX-C(or 40-DMX-CE) card, where the channels are further processed and dropped. "The following figure shows a functional block diagram of the 40-WSS-C or 40-WSS-CE card: Figure 3: 40-WSS-C or 40-WSS-CE Block Diagram:" According to Cisco's NCS 2000 Data Sheet 2, Cisco's ROADM includes one or more drop ports for selected spectral channels dropped from said multi-wavelength optical signal as follows: "The Cisco 16-port Flex Spectrum ROADM Line Card (16-WXC-FS) is a double-slot unit that provides multidegree switching capabilities not only at the individual wavelength level but also with flexible spectrum allocations. You can use the 16-port Flex Spectrum ROADM Line Card in the core of the network to build ROADM nodes with 96 channels spaced at 50-GHz, FlexSpectrum channels, or a combination of the two. By using a simple software reconfiguration, the same unit can provide colorless multiplexing and demultiplexing to ROADM nodes." Figure 4 of Cisco's NCS 2000 Data Sheet 2 provides a picture of the "16-port Flex Spectrum ROADM Line Card N-Degree ROADM Layout," which includes several WSS devices that include one or more other ports for second spectral channels as follows:

	
a wavelength-selective device for spatially separating said multiple spectral channels; and	The Cisco ROADMs include a wavelength-selective device for spatially separating said spectral channels. According to Cisco's Data Sheets and website, Cisco's ROADM products include a WSS-based card ("switching module"). The switching module includes a a wavelength-selective device for spatially separating said spectral channels.
a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements	The Cisco ROADMs include a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said ports and to control the power of the spectral channel reflected to said selected port, whereby a subset of said spectral channels is directed to said drop ports. According to Cisco's Data Sheets and website, Cisco's ROADM products include a WSS-based card

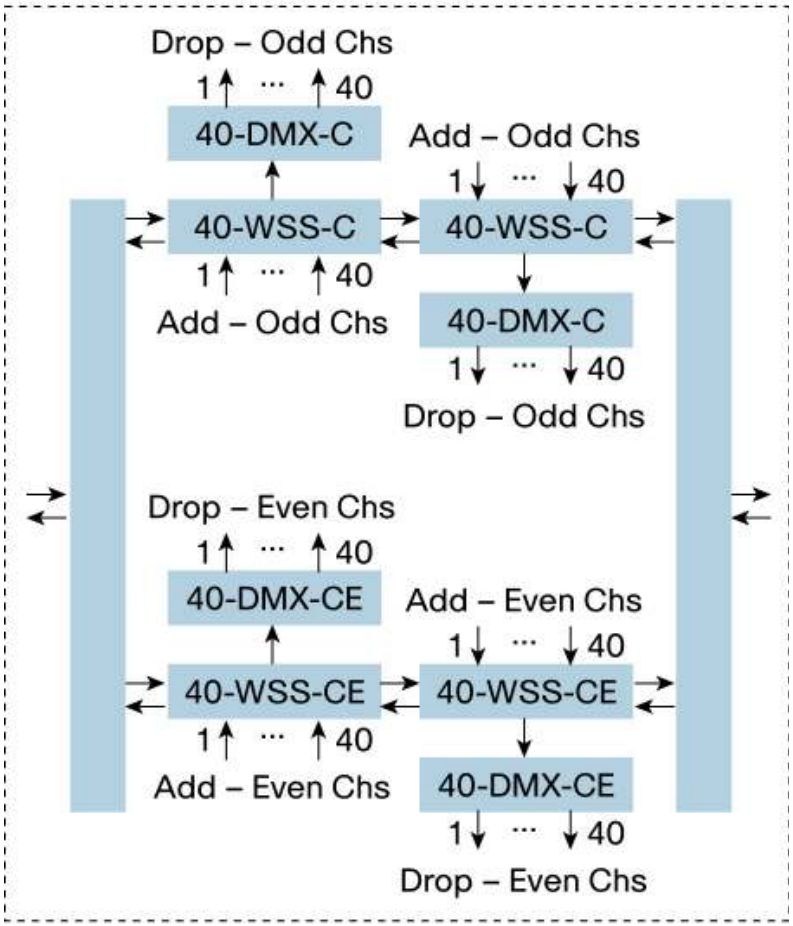
being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said ports and to control the power of the spectral channel reflected to said selected port, whereby a subset of said spectral channels is directed to said drop ports.	("switching module"). The switching module includes a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said ports and to control the power of the spectral channel reflected to said selected port, whereby a subset of said spectral channels is directed to said drop ports. According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide complete ROADM functionality and allow for the adding, dropping, multiplexing, switching, and routing of signals on an individual wavelength level. According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide ROADM functionality as follows: "The 40-WSS-C (or 40-WSS-CE) card works in combination with the 40-DMX-C (or 40-DMX-CE) card to implement ROADM functionality. As a ROADM node, the node can be configured at the optical channel level using CTC, Cisco Transport Planner, and CTM. ROADM functionality using the 40-WSS-C (or 40-WSS-CE) card requires two 40-WSS-C (or 40-WSS-CE) double-slot cards and two 40-DMX-C (or 40-DMX-CE) single-slot cards (for a total of six slots in the chassis)." According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide power monitoring functionality as follows: "The 40-WSS-C (or 40-WSS-CE) has physical diodes that monitor power at various locations on the card. The following table lists the physical diode descriptions." Cisco's ONS 15454 Data Sheet also states that it's 40-WXC-C component in its ROADM devices use "MEMS," which are micro-electromechanical mirrors, to switch (route/add/drop/attenuate/etc.) the signals.
16. An optical add-drop apparatus, comprising:	Cisco makes, uses, sells, imports, and/or offers to sell reconfigurable optical add drop multiplexers ("ROADMs") and other products that incorporate wavelength selective switches ("WSSs"), each of which is a wavelength separating-routing apparatus. Cisco makes, uses, sells, imports, and/or offers to sell reconfigurable optical add drop multiplexers

	("ROADMs") and other products that incorporate wavelength selective switches ("WSSs"), each of which is a wavelength separating-routing apparatus. Several documents detail the functionality of Cisco's ROADM products, including: • "Data Sheet: 40-Channel Reconfigurable Optical Add/Drop Multiplexing Portfolio for the Cisco ONS 15454 Multiservice Transport Platform," dated 1992-2007 ("ONS 15454 Data Sheet"); • "Data Sheet: Cisco NCS 2000 Service Line Cards," dated 2013 ("NCS 2000 Data Sheet 1"); • "Data Sheet: Cisco Network Convergence System 2000 ROADM and Amplifier Line Cards," dated 2013 ("NCS 2000 Data Sheet 2"); • "Cisco ONS 15200 Series DWDM Systems," from Cisco's website (www.cisco.com/c/en/us/products/optical-networking/ons-15200-series-dwdm-systems/index.html) ("ONS 15200 Webpage"); • "Data Sheet: Cisco ONS 15216 C L-Band Splitter/Combiner Module for Cisco ONS 15454 MSTP" dated 1992-2005 ("ONS 15200 Data Sheet"); • "Cisco NCS 2002 and NCS 2006 Line Card Configuration Guide, Release 10.x.x," chapter titled "Provisioning Reconfigurable Optical Add/Drop Cards," which "describes the line cards deployed in reconfigurable optical add/drop (ROADM) networks," pp12-16, which focus on the "40-WSS-C and 40-WSS-CE Card," and pp 31-38, which focus on "Single Module ROADM (SMR-C) Cards" ("ROADM Configuration Chapter"); and • information and documents available from Cisco's website (www.cisco.com) ("Website"). According to Cisco's ONS 15454 Data Sheet: "The Cisco® ONS 15454 Multiservice Transport Platform (MSTP) (Figure 1) provides a comprehensive, intelligent dense wavelength-division multiplexing (DWDM) solution for expanding metropolitan (metro) and regional bandwidth." Figure 1 is labeled as "40-Channel Wavelength Cross-Connect (40-WXC), Wavelength Selective Switch (40-WSS), Multiplexer (40-MUX), and Demultiplexer (40-DMX) Units." "While Wavelength Selective Switch (WSS) units provide degree-2 type reconfigurability (drop wavelength in a node vs. let it pass through the node), an ROADM node based on 40-WXC units can support up to degree-8 reconfigurability. This means that for each wavelength it is possible to decide if it has to be locally dropped or routed to any of the other 7 pass-through directions of the node. Such a

	capability not only enhances the flexibility of the DWDM transport network but also dramatically reduces the need for costly transponders to perform optical-to-electrical-to-optical conversion (typically 2 transponders/crossponders per add/drop channel or wavelength)." "As even in complex mesh network topologies it is likely that degree-2 reconfigurability would be enough for most of the node, the 40-channel ROADM portfolio includes also two different versions of the 40-WSS units, one operating on the odd channels of the C band spectrum (40-WSS-C) and the other one operating on the even channels of the C band spectrum (40-WSS-CE). The units can be used in conjunction with existing 32-channel ROADM solutions and with 40-WXC units to provide the greatest degree of flexibility for Cisco ONS 15454 MSTP deployments." "Embedded automatic power control mechanisms feature the possibility to interface with different types of DWDM units without requiring external attenuators. Used in conjunction with the 40-channel Multiplexer and 40-channel Demultiplexer allows to manage local add/drop traffic of the specific direction supported by the 40-WXC unit." "Embedded automatic power control mechanisms feature the possibility to interface with different type of DWDM units without requiring external attenuators." A chart in Cisco's ONS 15454 Data Sheet lists the components within the 40-Channel ROADM Units, including a "40-Channel Wavelength Selective Switch" The following figure 3 from Cisco's ONS 15454 Data Sheet is a chart of the "MSTP 40-Channel Degree-2 ROADM Node" and shows how wavelength selective switches (labeled "WSS") are integrated within a Cisco's ROADM:



The following figure 4 from Cisco's ONS 15454 Data Sheet is a chart of the "MSTP 80-Channel Degree-2 ROADM Node" and shows how wavelength selective switches (labeled "WSS") are integrated within a Cisco's ROADM and how Cisco's ROADM can add and drop signals:

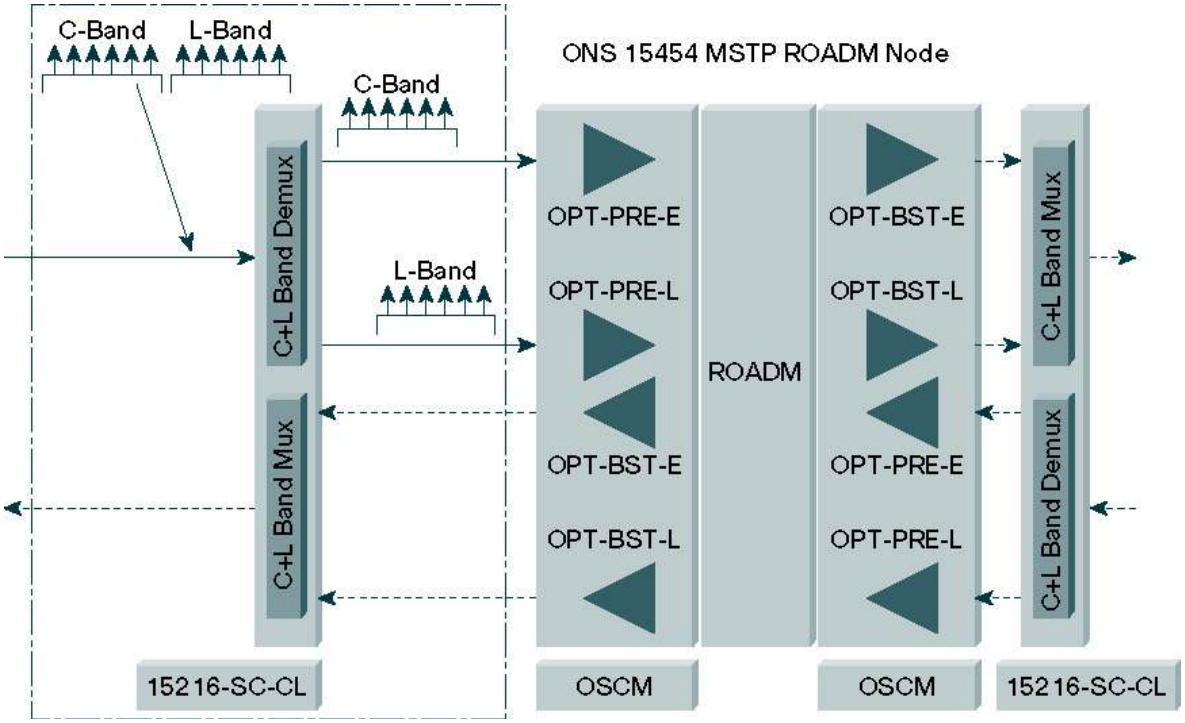


According to Cisco's ONS 15200 Data Sheet and ONS 15200 Webpage, both of which describe the ONS 15200 series of Cisco products, the ONS 15216 is the front end to the WSS ROADM in the ONS 15454. The ONS 15216 and ONS 15454 are integral to one another, so the ONS 15216 cannot work without the ONS 15454 and vice versa.

According to Cisco's ONS 15200 Webpage, "Cisco ONS 15200 Series DWDM Systems consist of

intuitive, compact, passive devices used in a variety of applications. These range from low latency, point-to-point data center interconnect to passive or reconfigurable optical add/drop multiplexer- (ROADM) based metropolitan rings."

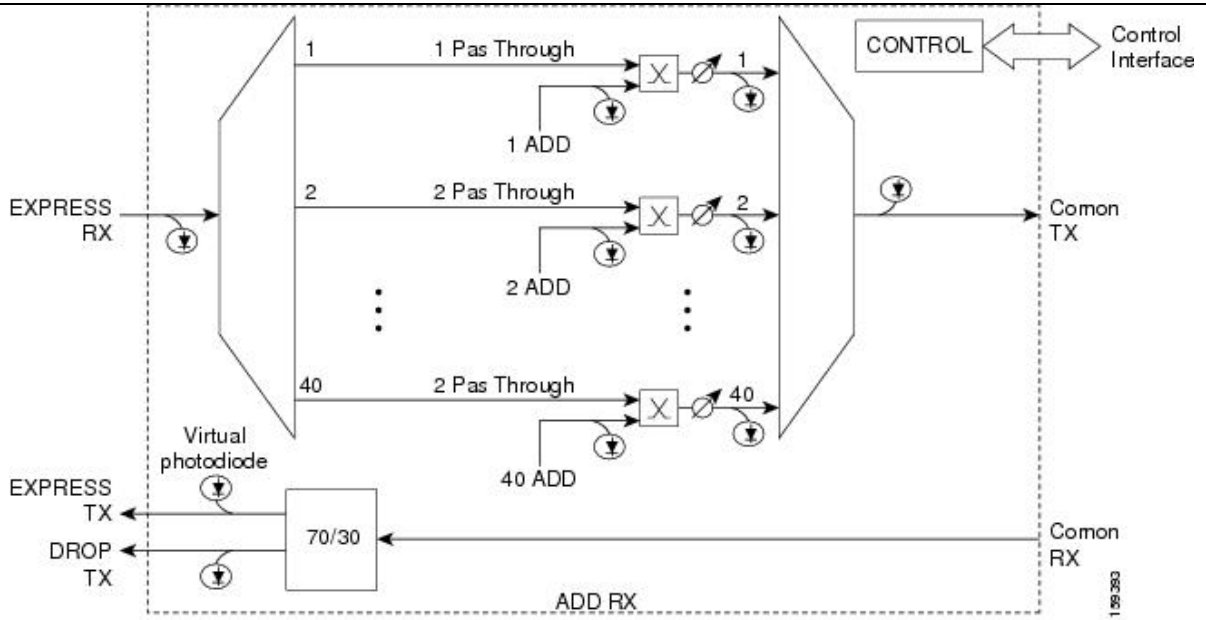
According to Cisco's ONS 15200 Data Sheet, Figure 3 describes "Cisco ONS 15216 C+L-Band Splitter/Combiner Module Deployed in a Cisco ONS 15454 MSTP ROADM Node" and depicts the relationship of Cisco's 15200 series products with Cisco's 15454 ROADM as follows:



According to Cisco's ROADM Configuration Chapter, the Single Module ROADM (SMR-C) Cards are "single-slot 40-channel single module ROADM (SMR-C) cards" and they "integrate the following functional blocks onto a single line card:
"• Optical preamplifier
• Optical booster amplifier

	• Optical service channel (OSC) filter • 2x1 wavelength cross-connect (WXC) or a 4x1 WXC • Optical channel monitor (OCM)" According to Cisco's ROADM Configuration Chapter, the Single Module ROADM (SMR-C) Cards "can manage up to 40 channels spaced at 100GHz on each port." Cisco's ROADM Configuration Chapter about provisioning reconfigurable optical add/drop cards describes the "40-WSS-C and 40-WSS-CE Card" as follows: "The double-slot 40-channel wavelength selective switch C-band (40-WSS-C) or the double-slot 40-channel wavelength selective switch even-channel C-band (40-WSS-CE) card switches 40 ITU-T 100-GHz-spaced channels identified in the channel plan (Table 4: Channel Allocation Plan or Table 5: Channel Allocation Plan) and sends them to dedicated output ports. The 40-WSS-C or 40-WSS-CE card is bidirectional and optically passive. The card can be installed in Slots 1 to 6 and 12 to 17 "The 40-WSS-C or 40-WSS-CE features include: • Receipt of an aggregate DWDM signal into 40 output optical channels from the Line receive port (EXP RX) in one direction and from the COM-RX port in the other direction. • Per-channel optical power monitoring using photodiodes. • Signal splitting in a 70%-to-30% ratio, sent to the 40-DMX-C (or 40-DMX-CE) for dropping signals, then to the other 40-WSS-C (or 40-WSS-CE) card. • Aggregate DWDM signal monitoring and control through a variable optical attenuator (VOA). In the case of electrical power failure, the VOA is set to its maximum attenuation for safety purposes. A manual VOA setting is also available." "Within the 40-WSS-C or 40-WSS-CE card, the first AWG opens the spectrum and each wavelength is directed to one of the ports of a 1x2 optical switch. The same wavelength can be passed through or stopped. If the pass-through wavelength is stopped, a new channel can be added at the ADD port. The card's second AWG multiplexes all of the wavelengths, and the aggregate signal is output through the COM-TX port." "The 40-WSS-C or 40-WSS-CE has eight types of ports: • ADD RX ports (1 to 40): These ports are used for adding channels. Each add channel is associated with an

	individual switch element that selects whether an individual channel is added. Each add port has optical power regulation provided by a VOA. The five connectors on the card faceplate accept MPO cables for the client input interfaces. MPO cables break out into eight separate cables. The 40-WSS-C or 40-WSS-CE card also has one LC-PC-II optical connector for the main input. • COM RX: The COM RX port receives the optical signal from a preamplifier (such as the OPT-PRE) and sends it to the optical splitter. • COM TX: The COM TX port sends an aggregate optical signal to a booster amplifier card (for example, the OPT-BST card) for transmission outside of the NE. • EXP RX port: The EXP RX port receives an optical signal from another 40-WSS-C or 40-WSS-CE card in the same NE. • EXP TX: The EXP TX port sends an optical signal to the other 40-WSS-C or 40-WSS-CE card within the NE. • DROP TX port: The DROP TX port sends the split off optical signal that contains drop channels to the 40-DMX-C(or 40-DMX-CE) card, where the channels are further processed and dropped. “The following figure shows a functional block diagram of the 40-WSS-C or 40-WSS-CE card: Figure 3: 40-WSS-C or 40-WSS-CE Block Diagram:”



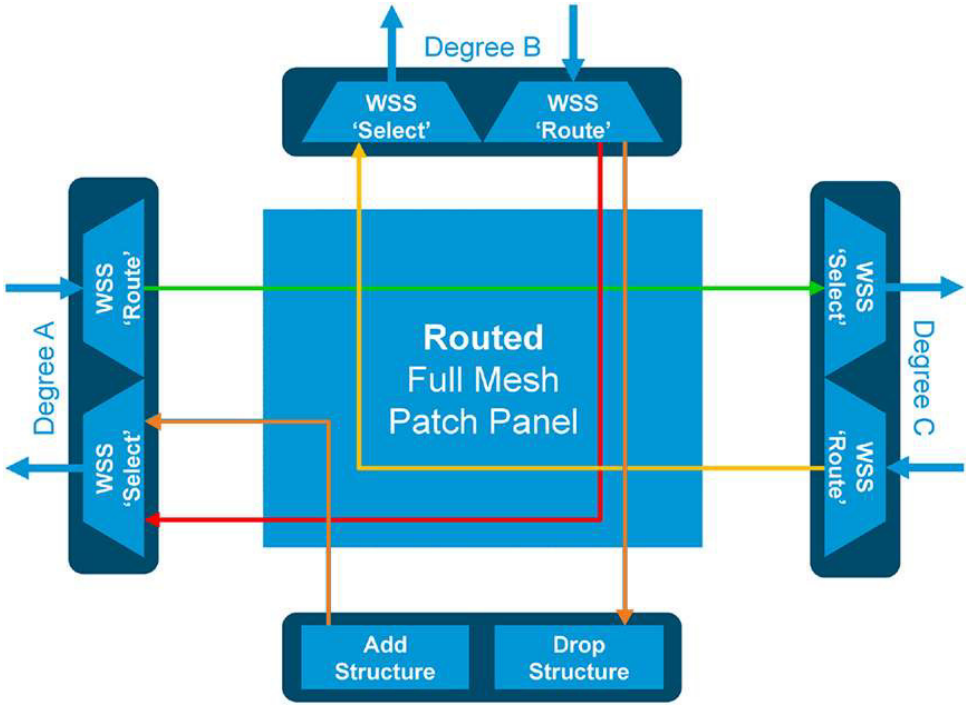
According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide ROADM functionality as follows:

"The 40-WSS-C (or 40-WSS-CE) card works in combination with the 40-DMX-C (or 40-DMX-CE) card to implement ROADM functionality. As a ROADM node, the node can be configured at the optical channel level using CTC, Cisco Transport Planner, and CTM. ROADM functionality using the 40-WSS-C (or 40-WSS-CE) card requires two 40-WSS-C (or 40-WSS-CE) double-slot cards and two 40-DMX-C (or 40-DMX-CE) single-slot cards (for a total of six slots in the chassis)."

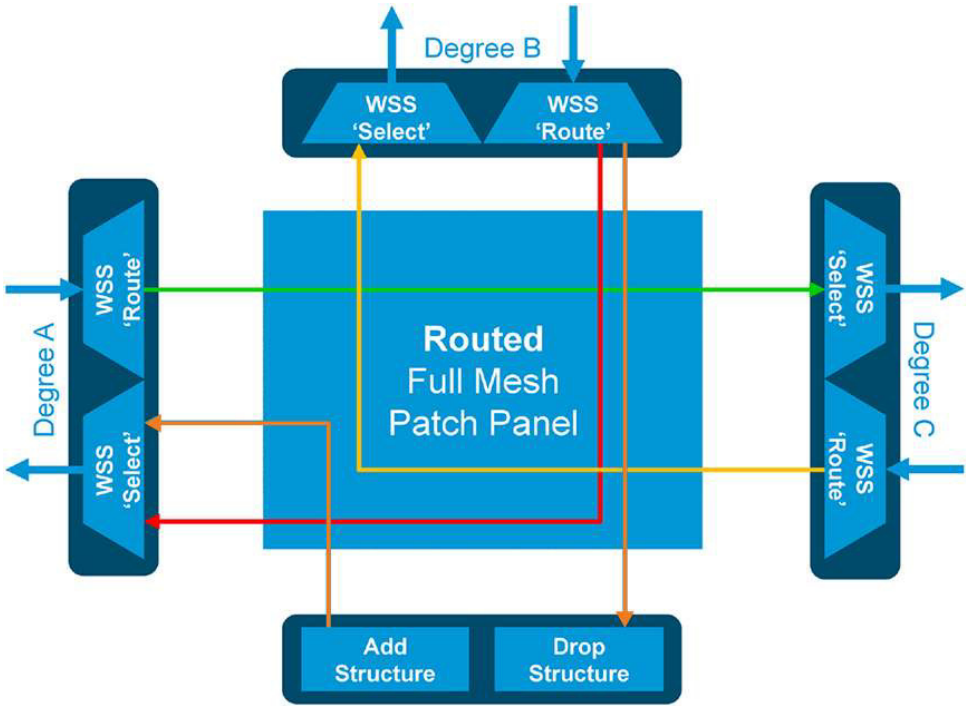
According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide power monitoring functionality as follows:

"The 40-WSS-C (or 40-WSS-CE) has physical diodes that monitor power at various locations on the card. The following table lists the physical diode descriptions."

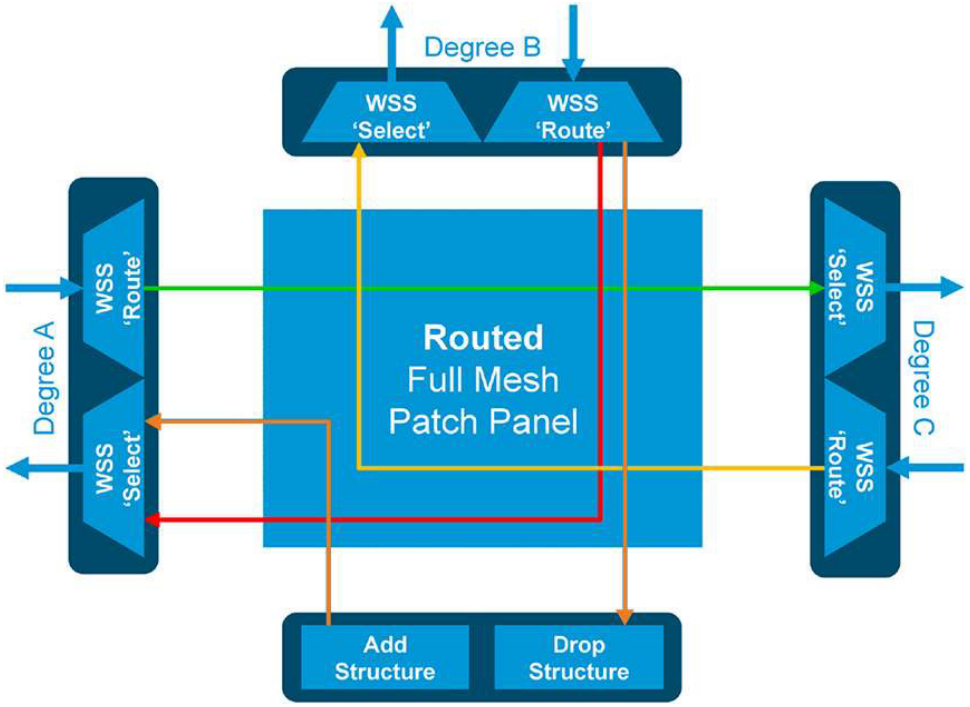
According to Cisco's NCS 2000 Data Sheet 2, Cisco provides a ROADM as follows:

	"The Cisco 16-port Flex Spectrum ROADM Line Card (16-WXC-FS) is a double-slot unit that provides multidegree switching capabilities not only at the individual wavelength level but also with flexible spectrum allocations. You can use the 16-port Flex Spectrum ROADM Line Card in the core of the network to build ROADM nodes with 96 channels spaced at 50-GHz, FlexSpectrum channels, or a combination of the two. By using a simple software reconfiguration, the same unit can provide colorless multiplexing and demultiplexing to ROADM nodes." Figure 4 of Cisco's NCS 2000 Data Sheet 2 provides a picture of the "16-port Flex Spectrum ROADM Line Card N-Degree ROADM Layout," which includes several WSS devices:  Cisco's ONS 15454 Data Sheet also states that it's 40-WXC-C component in its ROADM devices use "MEMS," which are micro-electromechanical mirrors, to switch (route/add/drop/attenuate/etc.) the signals.

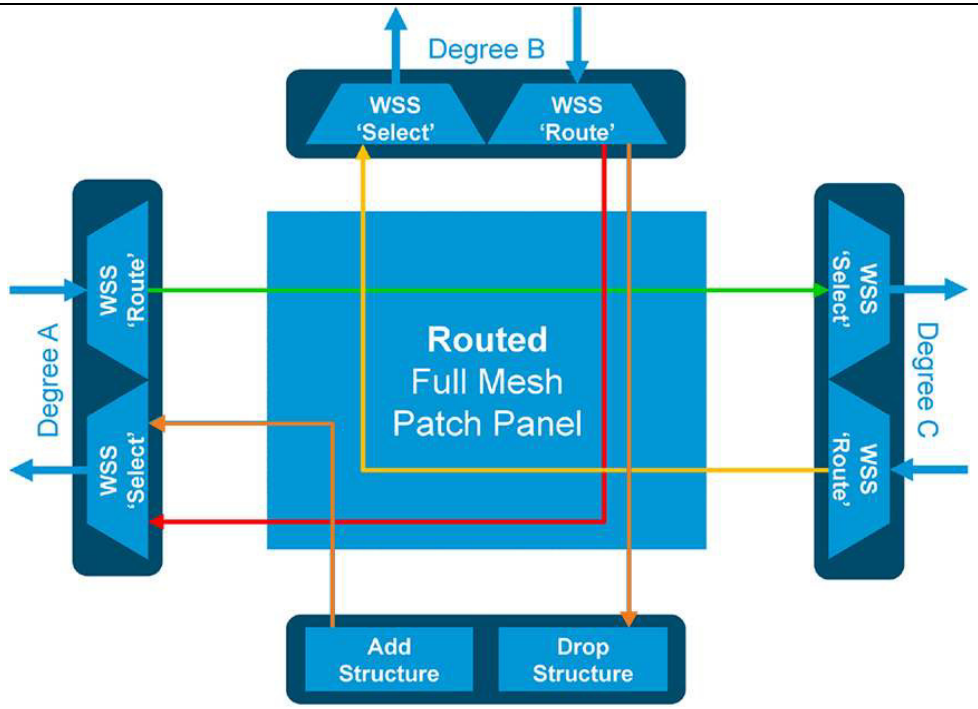
an input port for an input multi-wavelength optical signal having multiple spectral channels;	Cisco's ROADMs include an input port for an input multi-wavelength optical signal having multiple spectral channels. As shown in Cisco's ROADM Configuration Chapter about provisioning reconfigurable optical add/drop cards, Cisco's ROADM includes an input port for an input multi-wavelength optical signal having multiple spectral channels as follows: "The 40-WSS-C or 40-WSS-CE has eight types of ports: • ADD RX ports (1 to 40): These ports are used for adding channels. Each add channel is associated with an individual switch element that selects whether an individual channel is added. Each add port has optical power regulation provided by a VOA. The five connectors on the card faceplate accept MPO cables for the client input interfaces. MPO cables break out into eight separate cables. The 40-WSS-C or 40-WSS-CE card also has one LC-PC-II optical connector for the main input. • COM RX: The COM RX port receives the optical signal from a preamplifier (such as the OPT-PRE) and sends it to the optical splitter. • COM TX: The COM TX port sends an aggregate optical signal to a booster amplifier card (for example, the OPT-BST card) for transmission outside of the NE. • EXP RX port: The EXP RX port receives an optical signal from another 40-WSS-C or 40-WSS-CE card in the same NE. • EXP TX: The EXP TX port sends an optical signal to the other 40-WSS-C or 40-WSS-CE card within the NE. • DROP TX port: The DROP TX port sends the split off optical signal that contains drop channels to the 40-DMX-C(or 40-DMX-CE) card, where the channels are further processed and dropped. "The following figure shows a functional block diagram of the 40-WSS-C or 40-WSS-CE card: Figure 3: 40-WSS-C or 40-WSS-CE Block Diagram:" According to Cisco's NCS 2000 Data Sheet 2, Cisco's ROADM includes an input port for an input multi-wavelength optical signal having multiple spectral channels as follows: "The Cisco 16-port Flex Spectrum ROADM Line Card (16-WXC-FS) is a double-slot unit that provides multidegree switching capabilities not only at the individual wavelength level but also with flexible spectrum allocations. You can use the 16-port Flex Spectrum ROADM Line Card in the core of the

	network to build ROADM nodes with 96 channels spaced at 50-GHz, FlexSpectrum channels, or a combination of the two. By using a simple software reconfiguration, the same unit can provide colorless multiplexing and demultiplexing to ROADM nodes." Figure 4 of Cisco's NCS 2000 Data Sheet 2 provides a picture of the "16-port Flex Spectrum ROADM Line Card N-Degree ROADM Layout," which includes several WSS devices that include an input port for an input multi-wavelength optical signal having multiple spectral channels as follows: 
an output port for an output multi-wavelength optical signal;	Cisco's ROADMs include an output port for an output multi-wavelength optical signal. As shown in Cisco's ROADM Configuration Chapter about provisioning reconfigurable optical add/drop cards, Cisco's ROADM includes an output port for an output multi-wavelength optical signal:

	"The 40-WSS-C or 40-WSS-CE has eight types of ports: • ADD RX ports (1 to 40): These ports are used for adding channels. Each add channel is associated with an individual switch element that selects whether an individual channel is added. Each add port has optical power regulation provided by a VOA. The five connectors on the card faceplate accept MPO cables for the client input interfaces. MPO cables break out into eight separate cables. The 40-WSS-C or 40-WSS-CE card also has one LC-PC-II optical connector for the main input. • COM RX: The COM RX port receives the optical signal from a preamplifier (such as the OPT-PRE) and sends it to the optical splitter. • COM TX: The COM TX port sends an aggregate optical signal to a booster amplifier card (for example, the OPT-BST card) for transmission outside of the NE. • EXP RX port: The EXP RX port receives an optical signal from another 40-WSS-C or 40-WSS-CE card in the same NE. • EXP TX: The EXP TX port sends an optical signal to the other 40-WSS-C or 40-WSS-CE card within the NE. • DROP TX port: The DROP TX port sends the split off optical signal that contains drop channels to the 40-DMX-C(or 40-DMX-CE) card, where the channels are further processed and dropped. "The following figure shows a functional block diagram of the 40-WSS-C or 40-WSS-CE card: Figure 3: 40-WSS-C or 40-WSS-CE Block Diagram:" According to Cisco's NCS 2000 Data Sheet 2, Cisco's ROADM includes an output port for an output multi-wavelength optical signal as follows: "The Cisco 16-port Flex Spectrum ROADM Line Card (16-WXC-FS) is a double-slot unit that provides multidegree switching capabilities not only at the individual wavelength level but also with flexible spectrum allocations. You can use the 16-port Flex Spectrum ROADM Line Card in the core of the network to build ROADM nodes with 96 channels spaced at 50-GHz, FlexSpectrum channels, or a combination of the two. By using a simple software reconfiguration, the same unit can provide colorless multiplexing and demultiplexing to ROADM nodes." Figure 4 of Cisco's NCS 2000 Data Sheet 2 provides a picture of the "16-port Flex Spectrum ROADM Line Card N-Degree ROADM Layout," which includes several WSS devices that include an output port for an output multi-wavelength optical signal as follows:

	
one or more add ports for selected spectral channels to be added to said output multi-wavelength optical signal;	Cisco's ROADMs include one or more add ports for selected spectral channels to be added to said output multi-wavelength optical signal. As shown in Cisco's ROADM Configuration Chapter about provisioning reconfigurable optical add/drop cards, Cisco's ROADM includes one or more add ports for selected spectral channels to be added to said output multi-wavelength optical signal as follows: "The 40-WSS-C or 40-WSS-CE has eight types of ports: • ADD RX ports (1 to 40): These ports are used for adding channels. Each add channel is associated with an individual switch element that selects whether an individual channel is added. Each add port has optical power regulation provided by a VOA. The five connectors on the card faceplate accept MPO cables for the client input interfaces. MPO cables break out into eight separate cables. The 40-WSS-C or 40-WSS-CE

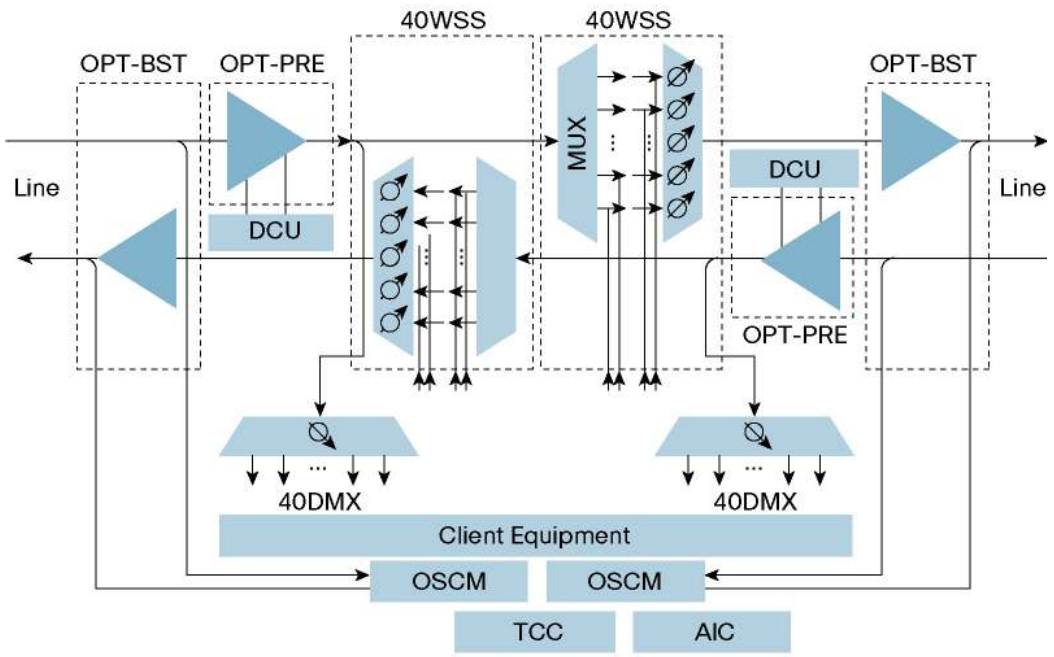
	card also has one LC-PC-II optical connector for the main input. • COM RX: The COM RX port receives the optical signal from a preamplifier (such as the OPT-PRE) and sends it to the optical splitter. • COM TX: The COM TX port sends an aggregate optical signal to a booster amplifier card (for example, the OPT-BST card) for transmission outside of the NE. • EXP RX port: The EXP RX port receives an optical signal from another 40-WSS-C or 40-WSS-CE card in the same NE. • EXP TX: The EXP TX port sends an optical signal to the other 40-WSS-C or 40-WSS-CE card within the NE. • DROP TX port: The DROP TX port sends the split off optical signal that contains drop channels to the 40-DMX-C(or 40-DMX-CE) card, where the channels are further processed and dropped. "The following figure shows a functional block diagram of the 40-WSS-C or 40-WSS-CE card: Figure 3: 40-WSS-C or 40-WSS-CE Block Diagram:" According to Cisco's NCS 2000 Data Sheet 2, Cisco's ROADM includes one or more add ports for selected spectral channels to be added to said output multi-wavelength optical signal as follows: "The Cisco 16-port Flex Spectrum ROADM Line Card (16-WXC-FS) is a double-slot unit that provides multidegree switching capabilities not only at the individual wavelength level but also with flexible spectrum allocations. You can use the 16-port Flex Spectrum ROADM Line Card in the core of the network to build ROADM nodes with 96 channels spaced at 50-GHz, FlexSpectrum channels, or a combination of the two. By using a simple software reconfiguration, the same unit can provide colorless multiplexing and demultiplexing to ROADM nodes." Figure 4 of Cisco's NCS 2000 Data Sheet 2 provides a picture of the "16-port Flex Spectrum ROADM Line Card N-Degree ROADM Layout," which includes several WSS devices that include one or more add ports for selected spectral channels to be added to said output multi-wavelength optical signal as follows:

	
a wavelength-selective device for reflecting said multiple and said selected spectral channels; and	The Cisco ROADMs include a wavelength-selective device for spatially separating said spectral channels. According to Cisco's Data Sheets and website, Cisco's ROADM products include a WSS-based card ("switching module"). The switching module includes a a wavelength-selective device for spatially separating said spectral channels.
a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements	The Cisco ROADMs include a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said ports and to control the power of the spectral channel reflected to said selected port, whereby said spectral channels from said add ports are selectively provided to said output port. According to Cisco's Data Sheets and website, Cisco's ROADM products include a WSS-based card

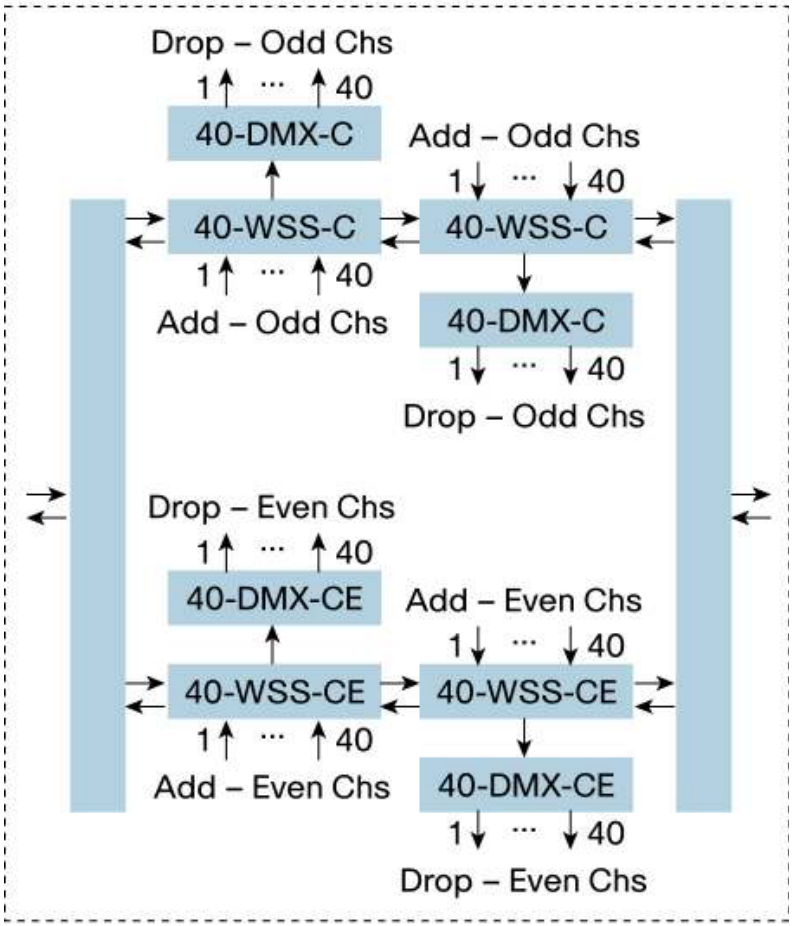
being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said ports and to control the power of the spectral channel reflected to said selected port, whereby said spectral channels from said add ports are selectively provided to said output port.	("switching module"). The switching module includes a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said ports and to control the power of the spectral channel reflected to said selected port, whereby said spectral channels from said add ports are selectively provided to said output port. According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide complete ROADM functionality and allow for the adding, dropping, multiplexing, switching, and routing of signals on an individual wavelength level. According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide ROADM functionality as follows: "The 40-WSS-C (or 40-WSS-CE) card works in combination with the 40-DMX-C (or 40-DMX-CE) card to implement ROADM functionality. As a ROADM node, the node can be configured at the optical channel level using CTC, Cisco Transport Planner, and CTM. ROADM functionality using the 40-WSS-C (or 40-WSS-CE) card requires two 40-WSS-C (or 40-WSS-CE) double-slot cards and two 40-DMX-C (or 40-DMX-CE) single-slot cards (for a total of six slots in the chassis)." According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide power monitoring functionality as follows: "The 40-WSS-C (or 40-WSS-CE) has physical diodes that monitor power at various locations on the card. The following table lists the physical diode descriptions." Cisco's ONS 15454 Data Sheet also states that it's 40-WXC-C component in its ROADM devices use "MEMS," which are micro-electromechanical mirrors, to switch (route/add/drop/attenuate/etc.) the signals.
17. A method of performing dynamic add and drop in a WDM optical network,	Cisco makes, uses, sells, imports, and/or offers to sell reconfigurable optical add drop multiplexers ("ROADMs") and other products that incorporate wavelength selective switches ("WSSs"), each of which is a wavelength separating-routing apparatus.

comprising:	Cisco makes, uses, sells, imports, and/or offers to sell reconfigurable optical add drop multiplexers ("ROADMs") and other products that incorporate wavelength selective switches ("WSSs"), each of which is a wavelength separating-routing apparatus. Several documents detail the functionality of Cisco's ROADM products, including: • "Data Sheet: 40-Channel Reconfigurable Optical Add/Drop Multiplexing Portfolio for the Cisco ONS 15454 Multiservice Transport Platform," dated 1992-2007 ("ONS 15454 Data Sheet"); • "Data Sheet: Cisco NCS 2000 Service Line Cards," dated 2013 ("NCS 2000 Data Sheet 1"); • "Data Sheet: Cisco Network Convergence System 2000 ROADM and Amplifier Line Cards," dated 2013 ("NCS 2000 Data Sheet 2"); • "Cisco ONS 15200 Series DWDM Systems," from Cisco's website (www.cisco.com/c/en/us/products/optical-networking/ons-15200-series-dwdm-systems/index.html) ("ONS 15200 Webpage"); • "Data Sheet: Cisco ONS 15216 C L-Band Splitter/Combiner Module for Cisco ONS 15454 MSTP" dated 1992-2005 ("ONS 15200 Data Sheet"); • "Cisco NCS 2002 and NCS 2006 Line Card Configuration Guide, Release 10.x.x," chapter titled "Provisioning Reconfigurable Optical Add/Drop Cards," which "describes the line cards deployed in reconfigurable optical add/drop (ROADM) networks," pp12-16, which focus on the "40-WSS-C and 40-WSS-CE Card," and pp 31-38, which focus on "Single Module ROADM (SMR-C) Cards" ("ROADM Configuration Chapter"); and • information and documents available from Cisco's website (www.cisco.com) ("Website"). According to Cisco's ONS 15454 Data Sheet: "The Cisco® ONS 15454 Multiservice Transport Platform (MSTP) (Figure 1) provides a comprehensive, intelligent dense wavelength-division multiplexing (DWDM) solution for expanding metropolitan (metro) and regional bandwidth." Figure 1 is labeled as "40-Channel Wavelength Cross-Connect (40-WXC), Wavelength Selective Switch (40-WSS), Multiplexer (40-MUX), and Demultiplexer (40-DMX) Units." "While Wavelength Selective Switch (WSS) units provide degree-2 type reconfigurability (drop wavelength in a node vs. let it pass through the node), an ROADM node based on 40-WXC units can support up to degree-8 reconfigurability. This means that for each wavelength it is possible to decide if it

	has to be locally dropped or routed to any of the other 7 pass-through directions of the node. Such a capability not only enhances the flexibility of the DWDM transport network but also dramatically reduces the need for costly transponders to perform optical-to-electrical-to-optical conversion (typically 2 transponders/crossponders per add/drop channel or wavelength)." "As even in complex mesh network topologies it is likely that degree-2 reconfigurability would be enough for most of the node, the 40-channel ROADM portfolio includes also two different versions of the 40-WSS units, one operating on the odd channels of the C band spectrum (40-WSS-C) and the other one operating on the even channels of the C band spectrum (40-WSS-CE). The units can be used in conjunction with existing 32-channel ROADM solutions and with 40-WXC units to provide the greatest degree of flexibility for Cisco ONS 15454 MSTP deployments." "Embedded automatic power control mechanisms feature the possibility to interface with different types of DWDM units without requiring external attenuators. Used in conjunction with the 40-channel Multiplexer and 40-channel Demultiplexer allows to manage local add/drop traffic of the specific direction supported by the 40-WXC unit." "Embedded automatic power control mechanisms feature the possibility to interface with different type of DWDM units without requiring external attenuators." A chart in Cisco's ONS 15454 Data Sheet lists the components within the 40-Channel ROADM Units, including a "40-Channel Wavelength Selective Switch" The following figure 3 from Cisco's ONS 15454 Data Sheet is a chart of the "MSTP 40-Channel Degree-2 ROADM Node" and shows how wavelength selective switches (labeled "WSS") are integrated within a Cisco's ROADM:

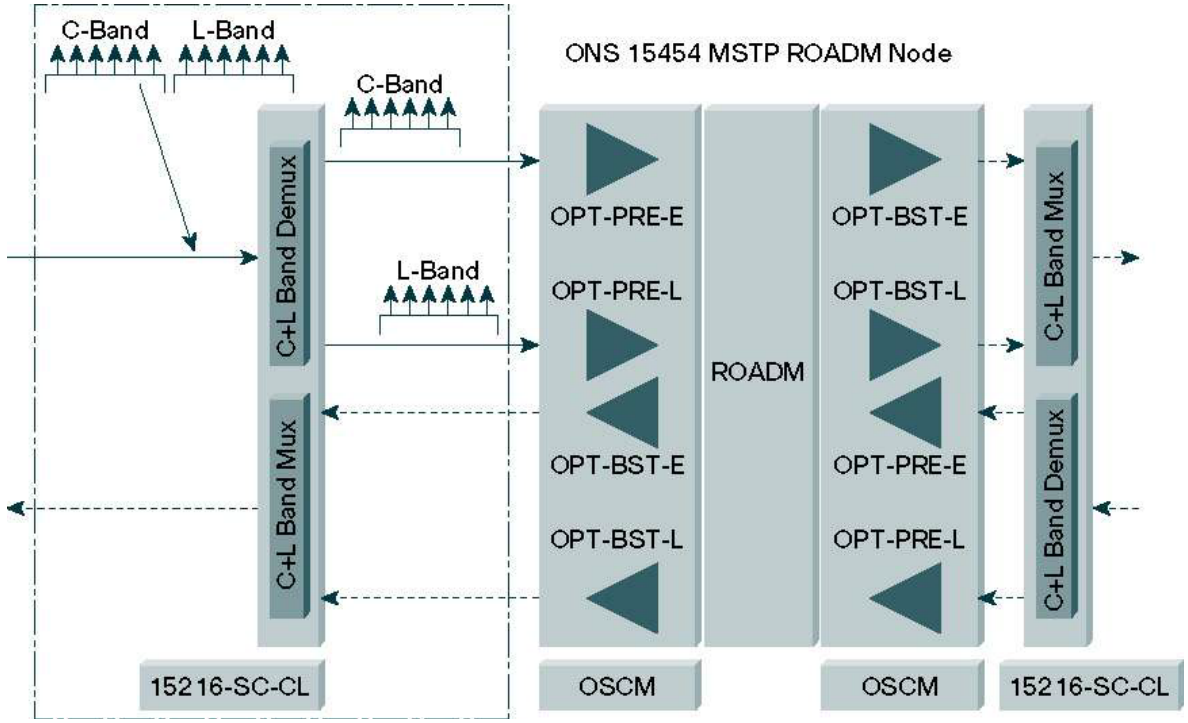


The following figure 4 from Cisco's ONS 15454 Data Sheet is a chart of the "MSTP 80-Channel Degree-2 ROADM Node" and shows how wavelength selective switches (labeled "WSS") are integrated within a Cisco's ROADM and how Cisco's ROADM can add and drop signals:



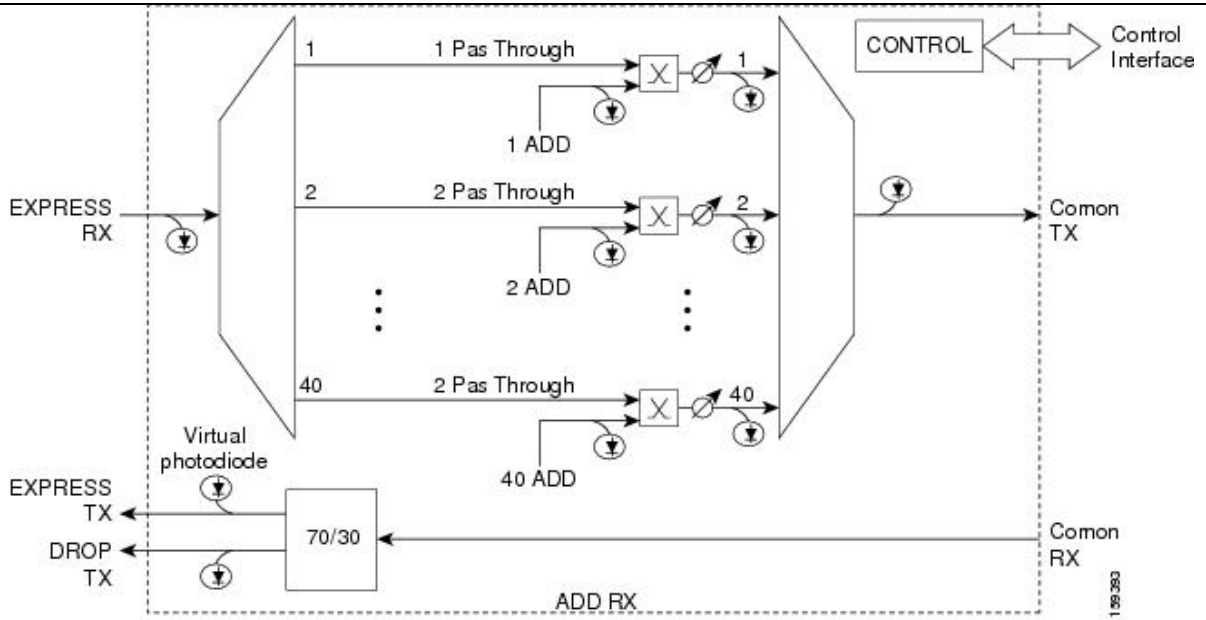
According to Cisco's ONS 15200 Data Sheet and ONS 15200 Webpage, both of which describe the ONS 15200 series of Cisco products, the ONS 15216 is the front end to the WSS ROADM in the ONS 15454. The ONS 15216 and ONS 15454 are integral to one another, so the ONS 15216 cannot work without the ONS 15454 and vice versa.

According to Cisco's ONS 15200 Webpage, "Cisco ONS 15200 Series DWDM Systems consist of

	intuitive, compact, passive devices used in a variety of applications. These range from low latency, point-to-point data center interconnect to passive or reconfigurable optical add/drop multiplexer- (ROADM) based metropolitan rings." According to Cisco's ONS 15200 Data Sheet, Figure 3 describes "Cisco ONS 15216 C+L-Band Splitter/Combiner Module Deployed in a Cisco ONS 15454 MSTP ROADM Node" and depicts the relationship of Cisco's 15200 series products with Cisco's 15454 ROADM as follows:  According to Cisco's ROADM Configuration Chapter, the Single Module ROADM (SMR-C) Cards are "single-slot 40-channel single module ROADM (SMR-C) cards" and they "integrate the following functional blocks onto a single line card: "• Optical preamplifier • Optical booster amplifier

	• Optical service channel (OSC) filter • 2x1 wavelength cross-connect (WXC) or a 4x1 WXC • Optical channel monitor (OCM)" According to Cisco's ROADM Configuration Chapter, the Single Module ROADM (SMR-C) Cards "can manage up to 40 channels spaced at 100GHz on each port." Cisco's ROADM Configuration Chapter about provisioning reconfigurable optical add/drop cards describes the "40-WSS-C and 40-WSS-CE Card" as follows: "The double-slot 40-channel wavelength selective switch C-band (40-WSS-C) or the double-slot 40-channel wavelength selective switch even-channel C-band (40-WSS-CE) card switches 40 ITU-T 100-GHz-spaced channels identified in the channel plan (Table 4: Channel Allocation Plan or Table 5: Channel Allocation Plan) and sends them to dedicated output ports. The 40-WSS-C or 40-WSS-CE card is bidirectional and optically passive. The card can be installed in Slots 1 to 6 and 12 to 17 "The 40-WSS-C or 40-WSS-CE features include: • Receipt of an aggregate DWDM signal into 40 output optical channels from the Line receive port (EXP RX) in one direction and from the COM-RX port in the other direction. • Per-channel optical power monitoring using photodiodes. • Signal splitting in a 70%-to-30% ratio, sent to the 40-DMX-C (or 40-DMX-CE) for dropping signals, then to the other 40-WSS-C (or 40-WSS-CE) card. • Aggregate DWDM signal monitoring and control through a variable optical attenuator (VOA). In the case of electrical power failure, the VOA is set to its maximum attenuation for safety purposes. A manual VOA setting is also available." "Within the 40-WSS-C or 40-WSS-CE card, the first AWG opens the spectrum and each wavelength is directed to one of the ports of a 1x2 optical switch. The same wavelength can be passed through or stopped. If the pass-through wavelength is stopped, a new channel can be added at the ADD port. The card's second AWG multiplexes all of the wavelengths, and the aggregate signal is output through the COM-TX port." "The 40-WSS-C or 40-WSS-CE has eight types of ports: • ADD RX ports (1 to 40): These ports are used for adding channels. Each add channel is associated with an

	individual switch element that selects whether an individual channel is added. Each add port has optical power regulation provided by a VOA. The five connectors on the card faceplate accept MPO cables for the client input interfaces. MPO cables break out into eight separate cables. The 40-WSS-C or 40-WSS-CE card also has one LC-PC-II optical connector for the main input. • COM RX: The COM RX port receives the optical signal from a preamplifier (such as the OPT-PRE) and sends it to the optical splitter. • COM TX: The COM TX port sends an aggregate optical signal to a booster amplifier card (for example, the OPT-BST card) for transmission outside of the NE. • EXP RX port: The EXP RX port receives an optical signal from another 40-WSS-C or 40-WSS-CE card in the same NE. • EXP TX: The EXP TX port sends an optical signal to the other 40-WSS-C or 40-WSS-CE card within the NE. • DROP TX port: The DROP TX port sends the split off optical signal that contains drop channels to the 40-DMX-C(or 40-DMX-CE) card, where the channels are further processed and dropped. “The following figure shows a functional block diagram of the 40-WSS-C or 40-WSS-CE card: Figure 3: 40-WSS-C or 40-WSS-CE Block Diagram:”



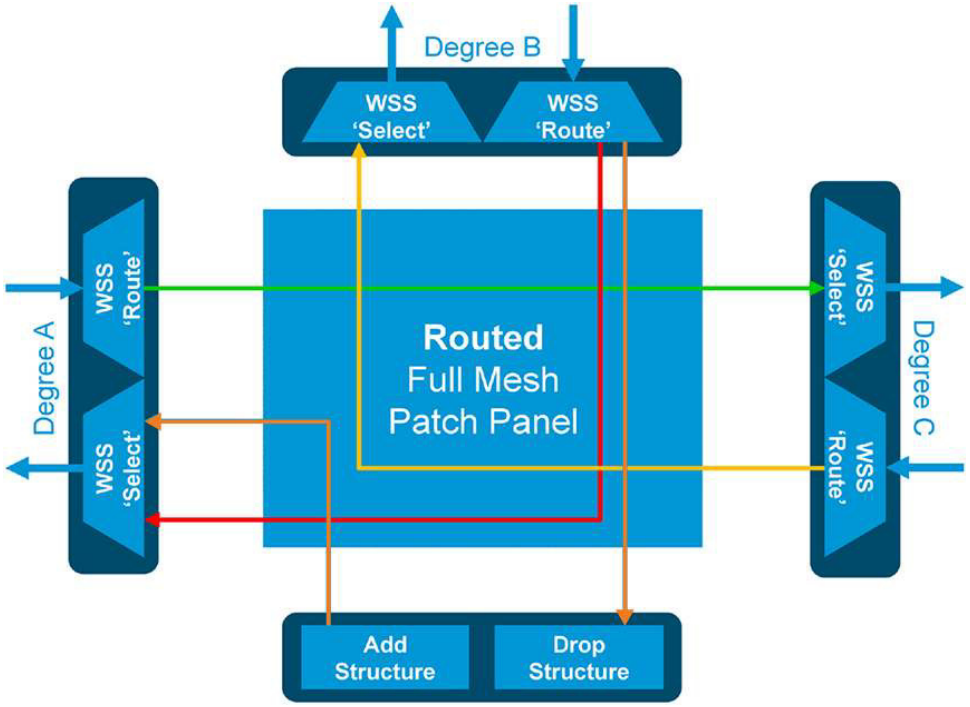
According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide ROADM functionality as follows:

"The 40-WSS-C (or 40-WSS-CE) card works in combination with the 40-DMX-C (or 40-DMX-CE) card to implement ROADM functionality. As a ROADM node, the node can be configured at the optical channel level using CTC, Cisco Transport Planner, and CTM. ROADM functionality using the 40-WSS-C (or 40-WSS-CE) card requires two 40-WSS-C (or 40-WSS-CE) double-slot cards and two 40-DMX-C (or 40-DMX-CE) single-slot cards (for a total of six slots in the chassis)."

According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide power monitoring functionality as follows:

"The 40-WSS-C (or 40-WSS-CE) has physical diodes that monitor power at various locations on the card. The following table lists the physical diode descriptions."

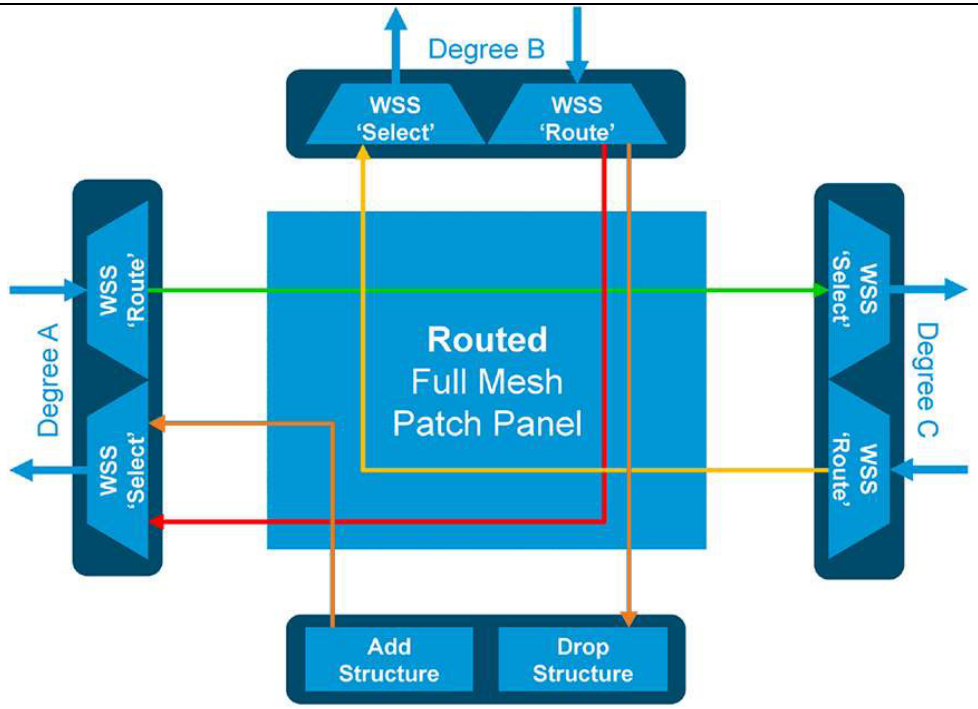
According to Cisco's NCS 2000 Data Sheet 2, Cisco provides a ROADM as follows:

	"The Cisco 16-port Flex Spectrum ROADM Line Card (16-WXC-FS) is a double-slot unit that provides multidegree switching capabilities not only at the individual wavelength level but also with flexible spectrum allocations. You can use the 16-port Flex Spectrum ROADM Line Card in the core of the network to build ROADM nodes with 96 channels spaced at 50-GHz, FlexSpectrum channels, or a combination of the two. By using a simple software reconfiguration, the same unit can provide colorless multiplexing and demultiplexing to ROADM nodes." Figure 4 of Cisco's NCS 2000 Data Sheet 2 provides a picture of the "16-port Flex Spectrum ROADM Line Card N-Degree ROADM Layout," which includes several WSS devices:  Cisco's ONS 15454 Data Sheet also states that it's 40-WXC-C component in its ROADM devices use "MEMS," which are micro-electromechanical mirrors, to switch (route/add/drop/attenuate/etc.) the signals.

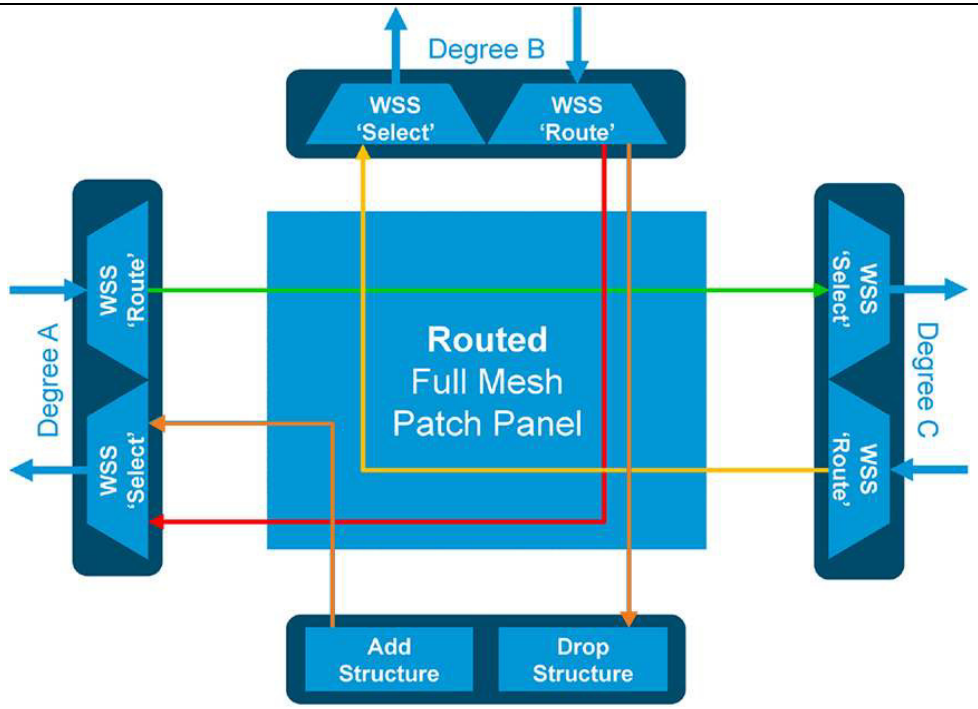
separating an input multi-wavelength optical signal into spectral channels;	Using its ROADMs, Cisco and others, acting at the direction and/or control of Cisco, separate said multi-wavelength optical signal into spectral channels. The Cisco ROADMs include a wavelength separator, for separating multi-wavelength optical signal from said input port into spectral channels. The Cisco ROADMs include a wavelength-selective device for spatially separating said spectral channels. According to Cisco's Data Sheets and website, Cisco's ROADM products include a WSS-based card ("switching module"). The switching module includes a a wavelength-selective device for spatially separating said spectral channels.
imaging each of said spectral channels onto a corresponding beam-deflecting element; and	Using its ROADMs, Cisco and others, acting at the direction and/or control of Cisco, images each of said spectral channels onto a corresponding beam-deflecting element. According to Cisco's Data Sheets and website, Cisco's ROADM products include a WSS-based card ("switching module"). The switching module includes a beam-focuser, for imaging each of said spectral channels onto a corresponding beam-deflecting element.
controlling dynamically and continuously said beam-deflecting elements in two dimensions so as to combine selected ones of said spectral channels into an output multi-wavelength optical signal and to control the power of the spectral channels combined into said output multi-wavelength optical	Using its ROADMs, Cisco and others, acting at the direction and/or control of Cisco, dynamically and continuously control said beam-deflecting elements in two dimensions so as to combine selected ones of said spectral channels into an output multi-wavelength optical signal and to control the power of the spectral channels combined into said output multi-wavelength optical signal. According to Cisco's Data Sheets and website, Cisco's ROADM products include a WSS-based card ("switching module"). The switching module includes a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect said corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports. According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide complete ROADM functionality and allow for the adding, dropping, multiplexing, switching, and routing of signals on an

signal.	individual wavelength level. According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide ROADM functionality as follows: "The 40-WSS-C (or 40-WSS-CE) card works in combination with the 40-DMX-C (or 40-DMX-CE) card to implement ROADM functionality. As a ROADM node, the node can be configured at the optical channel level using CTC, Cisco Transport Planner, and CTM. ROADM functionality using the 40-WSS-C (or 40-WSS-CE) card requires two 40-WSS-C (or 40-WSS-CE) double-slot cards and two 40-DMX-C (or 40-DMX-CE) single-slot cards (for a total of six slots in the chassis)." According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide power monitoring functionality as follows: "The 40-WSS-C (or 40-WSS-CE) has physical diodes that monitor power at various locations on the card. The following table lists the physical diode descriptions." Cisco's ONS 15454 Data Sheet also states that it's 40-WXC-C component in its ROADM devices use "MEMS," which are micro-electromechanical mirrors, to switch (route/add/drop/attenuate/etc.) the signals.
18. The method of claim 17, wherein said selected ones of said spectral channels comprises a subset of said spectral channels, such that other non-selected ones of said spectral channels are dropped from said output multi-wavelength optical signal.	Using its ROADMs, Cisco and others, acting at the direction and/or control of Cisco, can drop wavelengths. Cisco's ROADM devices include WSS-based switching module. The switching module can be operated so that said selected ones of said spectral channels comprises a subset of said spectral channels, such that other non-selected ones of said spectral channels are dropped from said output multi-wavelength optical signal. As shown in Cisco's ROADM Configuration Chapter about provisioning reconfigurable optical add/drop cards, Cisco's ROADMs include various ports and its ROADMs operate so that they can add and drop specific spectral channels: "The 40-WSS-C or 40-WSS-CE has eight types of ports: • ADD RX ports (1 to 40): These ports are used for adding channels. Each add channel is associated with an individual switch element that selects whether an individual channel is added. Each add port has optical

	power regulation provided by a VOA. The five connectors on the card faceplate accept MPO cables for the client input interfaces. MPO cables break out into eight separate cables. The 40-WSS-C or 40-WSS-CE card also has one LC-PC-II optical connector for the main input. • COM RX: The COM RX port receives the optical signal from a preamplifier (such as the OPT-PRE) and sends it to the optical splitter. • COM TX: The COM TX port sends an aggregate optical signal to a booster amplifier card (for example, the OPT-BST card) for transmission outside of the NE. • EXP RX port: The EXP RX port receives an optical signal from another 40-WSS-C or 40-WSS-CE card in the same NE. • EXP TX: The EXP TX port sends an optical signal to the other 40-WSS-C or 40-WSS-CE card within the NE. • DROP TX port: The DROP TX port sends the split off optical signal that contains drop channels to the 40-DMX-C(or 40-DMX-CE) card, where the channels are further processed and dropped. "The following figure shows a functional block diagram of the 40-WSS-C or 40-WSS-CE card: Figure 3: 40-WSS-C or 40-WSS-CE Block Diagram:" According to Cisco's NCS 2000 Data Sheet 2, Cisco's ROADMs include various ports and its ROADMs operate so that they can add and drop specific spectral channels: "The Cisco 16-port Flex Spectrum ROADM Line Card (16-WXC-FS) is a double-slot unit that provides multidegree switching capabilities not only at the individual wavelength level but also with flexible spectrum allocations. You can use the 16-port Flex Spectrum ROADM Line Card in the core of the network to build ROADM nodes with 96 channels spaced at 50-GHz, FlexSpectrum channels, or a combination of the two. By using a simple software reconfiguration, the same unit can provide colorless multiplexing and demultiplexing to ROADM nodes." Figure 4 of Cisco's NCS 2000 Data Sheet 2 provides a picture of the "16-port Flex Spectrum ROADM Line Card N-Degree ROADM Layout," which depicts the various ports its ROADMs use to operate so that they can add and drop specific spectral channels:

	
19. The method of claim 18, wherein said controlling comprises reflecting said non-selected ones of said spectral channels to one or more drop ports.	Using its ROADMs, Cisco and others, acting at the direction and/or control of Cisco, can drop wavelengths and/or can reflect said non-selected ones of said spectral channels to one or more drop ports. As shown in Cisco's ROADM Configuration Chapter about provisioning reconfigurable optical add/drop cards, Cisco's ROADMs include various ports and its ROADMs operate so that they can add and drop specific spectral channels: "The 40-WSS-C or 40-WSS-CE has eight types of ports: • ADD RX ports (1 to 40): These ports are used for adding channels. Each add channel is associated with an individual switch element that selects whether an individual channel is added. Each add port has optical power regulation provided by a VOA. The five connectors on the card faceplate accept MPO cables for the client input interfaces. MPO cables break out into eight separate cables. The 40-WSS-C or 40-WSS-CE card also has one LC-PC-II optical connector for the main input.

	• COM RX: The COM RX port receives the optical signal from a preamplifier (such as the OPT-PRE) and sends it to the optical splitter. • COM TX: The COM TX port sends an aggregate optical signal to a booster amplifier card (for example, the OPT-BST card) for transmission outside of the NE. • EXP RX port: The EXP RX port receives an optical signal from another 40-WSS-C or 40-WSS-CE card in the same NE. • EXP TX: The EXP TX port sends an optical signal to the other 40-WSS-C or 40-WSS-CE card within the NE. • DROP TX port: The DROP TX port sends the split off optical signal that contains drop channels to the 40-DMX-C(or 40-DMX-CE) card, where the channels are further processed and dropped. "The following figure shows a functional block diagram of the 40-WSS-C or 40-WSS-CE card: Figure 3: 40-WSS-C or 40-WSS-CE Block Diagram:" According to Cisco's NCS 2000 Data Sheet 2, Cisco's ROADMs include various ports and its ROADMs operate so that they can add and drop specific spectral channels: "The Cisco 16-port Flex Spectrum ROADM Line Card (16-WXC-FS) is a double-slot unit that provides multidegree switching capabilities not only at the individual wavelength level but also with flexible spectrum allocations. You can use the 16-port Flex Spectrum ROADM Line Card in the core of the network to build ROADM nodes with 96 channels spaced at 50-GHz, FlexSpectrum channels, or a combination of the two. By using a simple software reconfiguration, the same unit can provide colorless multiplexing and demultiplexing to ROADM nodes." Figure 4 of Cisco's NCS 2000 Data Sheet 2 provides a picture of the "16-port Flex Spectrum ROADM Line Card N-Degree ROADM Layout," which depicts the various ports its ROADMs use to operate so that they can add and drop specific spectral channels:

	
20. The method of claim 17 further comprising imaging other spectral channels onto other corresponding beam-deflecting elements, and controlling dynamically and continuously said other beam-deflecting elements so as to combine said other spectral channels with said selected ones of	Using its ROADMs, Cisco and others, acting at the direction and/or control of Cisco, image other spectral channels onto other corresponding beam-deflecting elements, and control dynamically and continuously said other beam-deflecting elements so as to combine said other spectral channels with said selected ones of said spectral channels into said output multi-wavelength optical signal. According to Cisco's Data Sheets and website, Cisco's ROADM products include a WSS-based card ("switching module"). The switching module includes a beam-focuser, for imaging each of said spectral channels onto a corresponding beam-deflecting element. According to Cisco's Data Sheets and website, Cisco's ROADM products include a WSS-based card ("switching module"). The switching module includes a beam-deflecting elements that are capable of being dynamically and continuously controlled so as to combine spectral channels and create a output multi-wavelength optical signal.

said spectral channels into said output multi-wavelength optical signal.	According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide complete ROADM functionality and allow for the adding, dropping, multiplexing, switching, and routing of signals on an individual wavelength level. According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide ROADM functionality as follows: "The 40-WSS-C (or 40-WSS-CE) card works in combination with the 40-DMX-C (or 40-DMX-CE) card to implement ROADM functionality. As a ROADM node, the node can be configured at the optical channel level using CTC, Cisco Transport Planner, and CTM. ROADM functionality using the 40-WSS-C (or 40-WSS-CE) card requires two 40-WSS-C (or 40-WSS-CE) double-slot cards and two 40-DMX-C (or 40-DMX-CE) single-slot cards (for a total of six slots in the chassis)." According to Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide power monitoring functionality as follows: "The 40-WSS-C (or 40-WSS-CE) has physical diodes that monitor power at various locations on the card. The following table lists the physical diode descriptions." Cisco's ONS 15454 Data Sheet also states that it's 40-WXC-C component in its ROADM devices use "MEMS," which are micro-electromechanical mirrors, to switch (route/add/drop/attenuate/etc.) the signals.
21. The method of claim 17, wherein said imaging comprises focusing said spectral channels onto said beam-deflecting elements.	Using its ROADMs, Cisco and others, acting at the direction and/or control of Cisco, focus said spectral channels onto said beam-deflecting elements. According to Cisco's Data Sheets and website, Cisco's ROADM products include a WSS-based card ("switching module"). The switching module includes a beam-focuser, for imaging spectral channels onto a beam-deflecting element.
22. The method of claim 17 further comprising	Using its ROADMs as described in claim 17, Cisco and others, acting at the direction and/or control of Cisco, further monitor a power level in one or more of said selected ones of said spectral channels, and

monitoring a power level in one or more of said selected ones of said spectral channels, and controlling an alignment between said input multi-wavelength optical signal and corresponding beam-deflecting elements in response to said monitoring.	control an alignment between said input multi-wavelength optical signal and corresponding beam-deflecting elements in response to said monitoring. As set forth in Cisco's ROADM Configuration Chapter, Cisco's WSS cards provide "per-channel optical power monitoring using photodiodes" and "aggregate DWDM signal monitoring and control through a variable optical attenuator." In Cisco's ONS 15454 Data Sheet, Cisco describes the servo-control mechanism in its ROADM by explaining the dynamic control capabilities of its product as follows: "Embedded automatic power control mechanisms allow interfacing with different types of DWDM units without requiring external attenuators. Used in conjunction with Cisco ONS multiplexers and demultiplexers, these mechanisms allow the management of local add/drop traffic in the specific direction supported by the 80-WXC-C unit. "The Cisco ONS 15454 80-WXC-C card operates on the ITU 50-GHz wavelength plan. The card integrates automatic per-channel power monitor and control capabilities, providing node- and network-based automatic-power-level management on each input and output port. Per-channel optical path selection is also done in a completely automated way through Wavelength Path Provisioning (WPP) at the network level, featuring end-to-end, point-and-click wavelength provisioning and easy SONET/SDH-like wavelength management." Cisco's ONS 15454 Data Sheet also states that it's 40-WXC-C component in its ROADM devices use "MEMS," which are micro-electromechanical mirrors, to switch (route/add/drop/attenuate/etc.) the signals.